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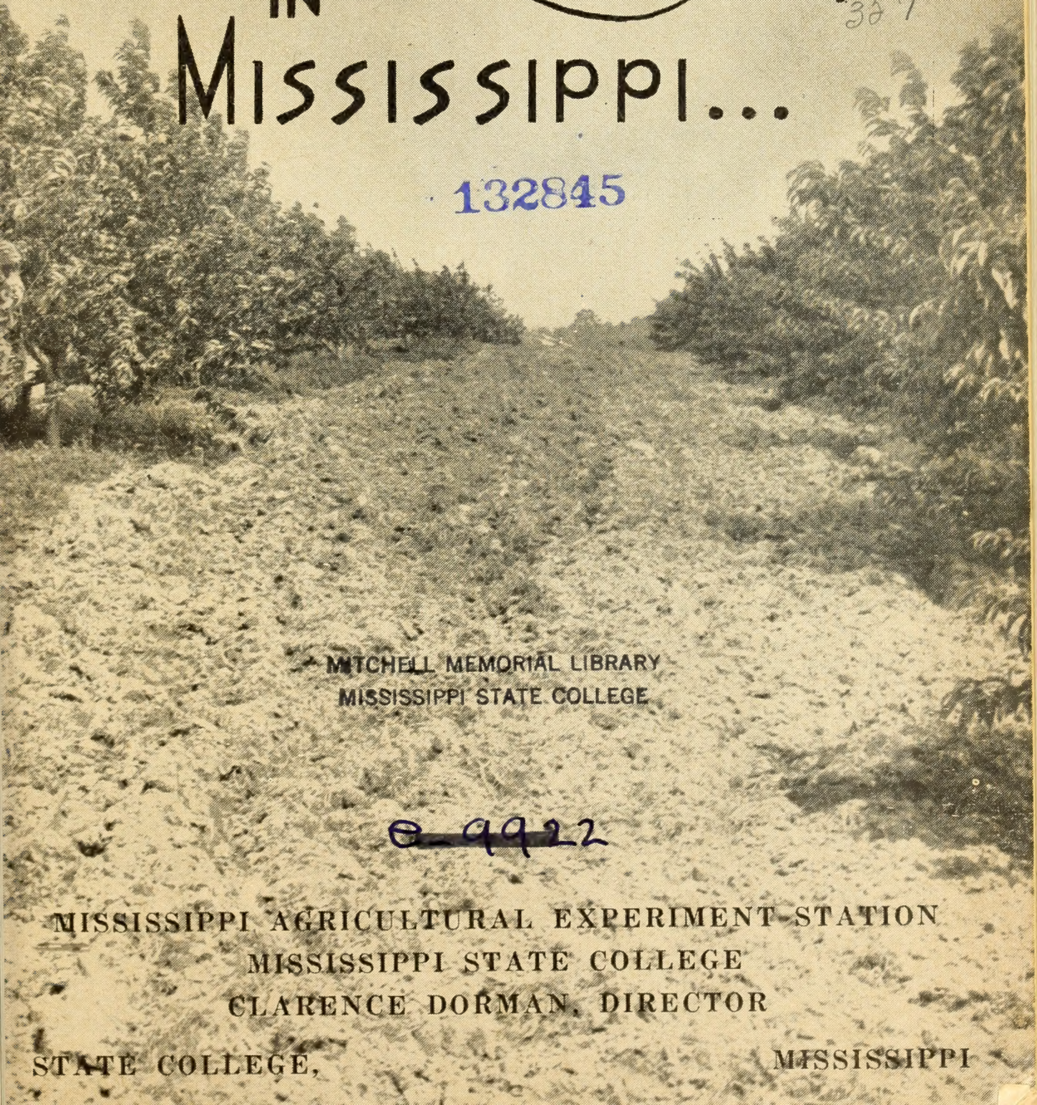

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Home Orchards In Mississippi

By TROY H. JONES and T. E. ASHLEY*

Within recent years practically all the agricultural agencies of both the State and Federal Government have stressed diversified farming and a live-at-home program. Mississippi has recently made great strides along these lines, yet a very small percentage of the farms have well kept home orchards to supply the home with fresh and canned fruits throughout the year. Therefore, the purpose of this bulletin is to aid in the establishment and maintenance of the home orchard.

Perhaps it should be pointed out that research workers are constantly testing new orchard practices, and developing and testing new fruit varieties. On this account, present day recommendations may differ in some respects to recommendations of just a few years ago, and it is to be expected that orchard recommendations of the future may differ in some respects from those of today. Especially is this true regarding varieties. The writers have endeavored to recommend only the latest and best practices, and the recommendations presented in this bulletin are those which have been employed and are now being used in the production of fruits in the Experiment Station orchards.

Successive phases of fruit production discussed in this bulletin include the following: establishing the orchard; training and pruning of fruit trees, grapes, and brambles; orchard soil management and fertilization; fruit thinning; insects and diseases and their control; and varieties.

ESTABLISHING THE ORCHARD

Selecting Site

In choosing a site for the home orchard, such factors as soil type and drainage, elevation and slope of land, and nearness to the house should be considered. Too often the home orchard has been located on the poorest soil on the farm, resulting in many instances in a complete failure of the plants to produce enough fruit for home consumption.

Most fruit plants will adjust themselves to a wide range of soil types. In general, the peaches, plums, grapes, strawberries, and brambles do best on the lighter loam types, while the apples and pears thrive best on the heavier loam lands. The soil should provide for an extensive root range, be well drained, reasonably fertile, of good texture, and contain an appreciable amount of organic matter.

Since cold air settles to the lower levels, the elevation of the land should be such as to provide for a continuous movement of air through and away from the planting, to reduce to a minimum the hazard of frost injury to the blossoms. Furthermore, fungus diseases are more prevalent in low areas where the foliage of the plant dries off slowly and the air is still.

The orchard should be conveniently located near the house, protected from livestock, and should fit in with the general landscape program of the farmstead.

Obtaining Nursery Stock

It is false economy to purchase cheap nursery stock for the orchard. Those plants sold at bargain prices are usually of inferior grade and in most instances are not vigorous and do not attain the size they should, even with the best of care. The best plants in any given age group should be purchased. This does not necessarily mean that they must be expensive, as many nurseries have very good plants available at reasonable prices.

In most instances, nursery stock of tree fruits is sold as 1-year-olds and 2-year-olds. An exception to this is the peach, which is also sold as June buds (those budded in May or June and transplanted the following dormant season). In each age group there are three size groups: large, medium, and small. Grapes and brambles are usually sold according to age only; that is, 1 year or 2 years of age. Since 1-year-old plants withstand the shock of transplanting better than the 2-year-olds, they are recommended for the orchard. In any instance, nothing less than the medium size in any particular age group should be used.

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If for any reason it is impossible to set the plants immediately after arrival from the nursery they should be heeled in by plowing out a deep furrow and placing them in a sloping position against the furrow side of the trench and covering the roots with moist soil, as illustrated in figure 1.

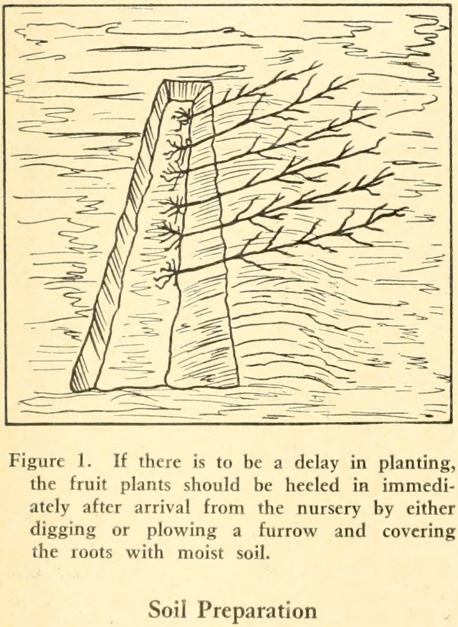

Figure 1. If there is to be a delay in planting, the fruit plants should be heeled in immediately after arrival from the nursery by either digging or plowing a furrow and covering the roots with moist soil.

Soil Preparation

It is very important that the soil be well prepared before setting the plants, since it will be practically impossible to break the land after they are set out. Unless a tilled crop was grown the previous year on the land selected for the orchard, it should be well broken in the early fall before setting the plants. This will permit the ground to settle and an abundant supply of moisture to be absorbed. Immediately before setting the plants, the land should be disked and harrowed until it is friable and in good physical condition.

Laying Out the Orchard

The system used to lay out the orchard will be determined largely by the topography of the land. On rolling land, of 2 percent and more slope, the contour method of planting should be adopted. Under this method, losses of topsoil and moisture, which occur on cultivated erodible sites, are reduced to a minimum. Contour planting in itself, however, is not an effective means of controlling erosion, and should be accompanied by terracing or ridging and contour cultivation.

Terraces should be constructed before setting the trees. The tree rows may then be laid off parallel to the terraces much in the same manner as annual crops, with no effort being made to keep the trees aligned up and down the slope, as shown in figure 2-C, or the main tree rows may be located on or near the top of the terraces, never in or near the terrace channel, with some attention being given to aligning the trees in more or less of a straight line up and down the slope, as shown in figure 2-D. By the former arrangement, upkeep of terrace ridges is simplified when one has limited equipment with which to work. By following the latter pattern, an orchardist plants his trees on top of the terrace, which is his best soil, and possibly provides better air drainage.

As the slope varies, there will be a varying distance between the terrace ridges. This flexibility in distance, so typical of contour plantings, will allow for point or spur rows. These interterrace tree rows should be ridged up 6 to 8 inches above the general level of the land by making three or four rounds with a two-horse turning plow. These tree row ridges act as low water

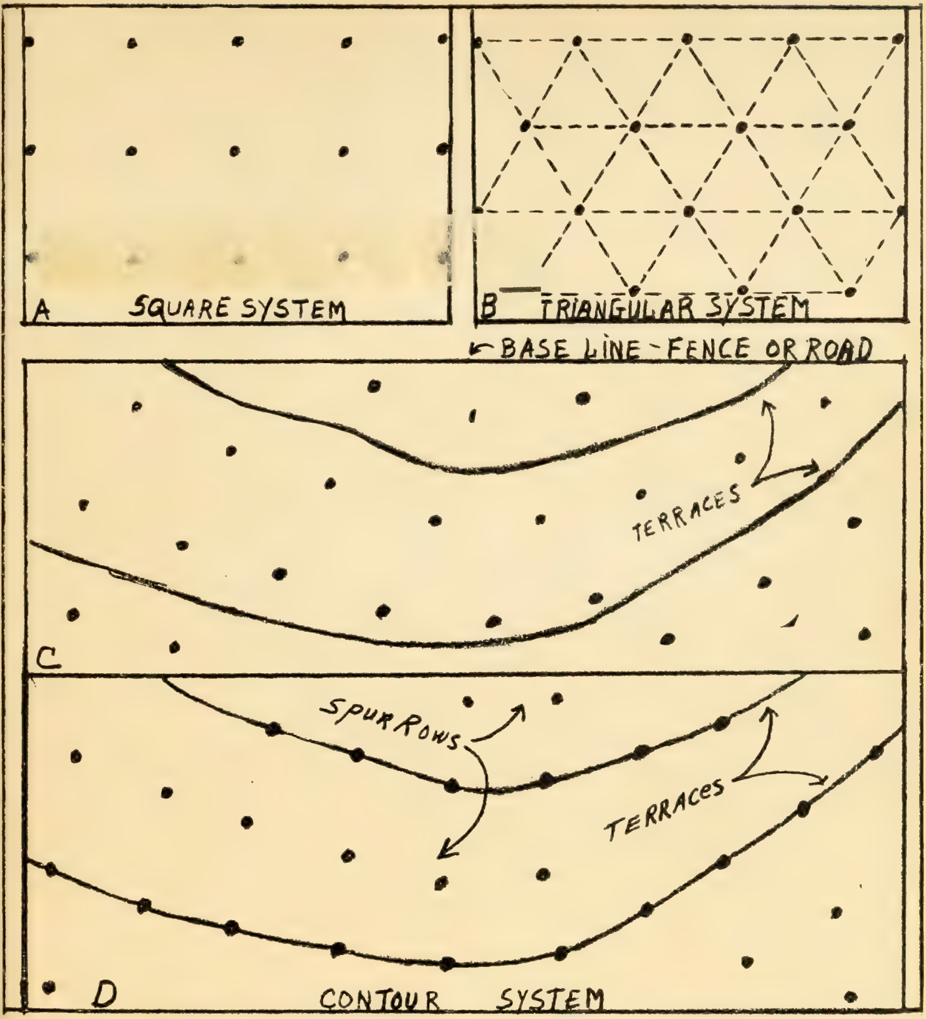

Figure 2. Illustrating the square, triangular, and contour systems of planting.

barriers and thereby strengthen the terracing program.

Regardless of how the plants are placed with respect to the terrace, provision must be made to maintain the terraces as a functioning unit.

If the land does not need terracing and the orchard is sufficiently large to allow for planting one particular kind of fruit in a block, the square or triangular system should be used, as illustrated in figure 2, A and B.

In the square system the trees are equidistant and at right angles to each other. To establish this system erect base line A-B (see figure 3) on one side of the plot of ground, placing stakes at positions where the trees are to be set. Place stake C on base line A-B, 40 feet from point A.

From point A measure 30 feet at an approximate right angle to line A-B and set stake D. Change position of stake D without altering other measurements until line C-D is exactly 50 feet. On line A-D place stakes where the trees are to be set. The positions of the other trees

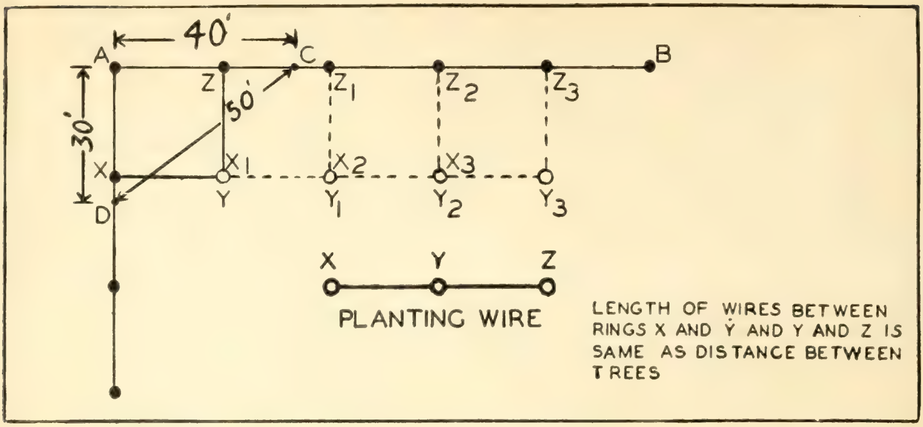
40'
A
C
B
Z
Z1
Z2
Z3
50'
30'
X
X1
X2
X3
D
Y
Y1
Y2
Y3
X
Y
Z
PLANTING WIRE
LENGTH OF WIRES BETWEEN RINGS X AND Y AND Y AND Z IS SAME AS DISTANCE BETWEEN TREES

Figure 3. Illustrating in detail the laying out of an orchard according to the square system. After the base lines have been established, place rings X and Z of the planting wire over the first stake of each of the base lines and pull ring Y until the wires are equally tight. This will locate the position of the second tree of the second row. Continue this process until the orchard is laid out.

are found by using the planting wire. Place rings X and Z over the first stake of each of the base lines and pull ring Y until the wires are equally tight. This will locate the position of the second tree on the second row. Continue this process until the orchard is laid out.

In the triangular system the trees are equidistant and from equilateral triangles. To establish this system, erect base line A-B as shown in figure 4 and place stakes at positions where the plants are to be set. With the planting wire place rings X and Z over the first and second stakes of the base line. Pull ring Y until wires are equally tight and place stake at Y. This will locate the position of the first tree on the second row. Continue this process until the orchard is laid out. When this system is used about 15 percent more trees may be set on a given piece of land than when the square system is used.

In the small non-terraced home orchard of one-fourth to one acre where several different kinds of fruit are to be planted, which involve an assortment of planting distances, it is not necessary to adhere to either the triangular or square system. Too much space is thereby sacrificed for the sake of a conventional planting de-

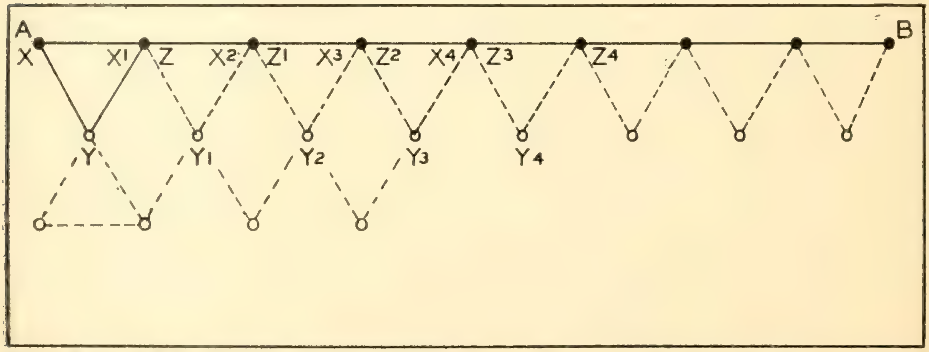

Figure 4. Laying out the orchard by the triangular system. After base line A-B has been established place rings X and Z of the planting wire over the first and second stakes and pull ring Y until the wires are tight. This will locate the position of the first tree of the second row. Continue this process until the orchard is laid out.

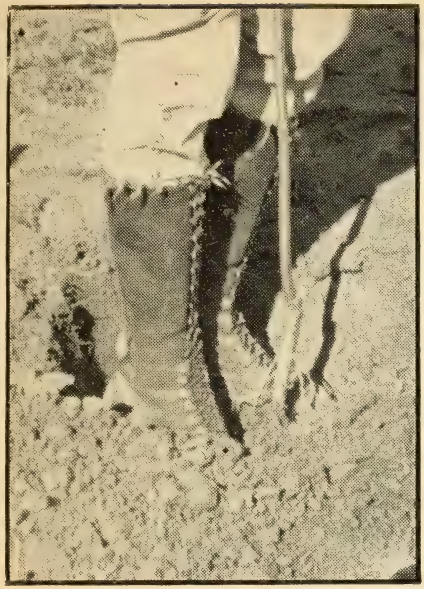

Figure 5. The soil should be well tamped about the roots of the tree. Do not mix fertilizer with the soil.

sign. Orderly arrangement of rows and trees in the row can be attained without following either of above two patterns.

Setting the Plants

If conditions are favorable the plants should be set during early winter, probably December. At this time the plants are completely dormant, and if set then the roots will have ample time to become established in the soil before growth starts in the spring.

The holes made for setting the plants should be large enough to receive the roots without bending them from their natural positions, and deep enough so that the plants may be set from 1 inch to 2 inches deeper than they stood in the nursery row. Before the plants are set, all broken and bruised roots should be removed and any long slender roots may be cut back to normal length

In filling the hole the topsoil should be put back first and worked in firmly about the tree roots as shown in figure 5. This is probably the most important single factor in setting plants, for if the soil is well tamped it reduces to a minimum the air spaces in the soil. Neither commercial fertilizer nor barnyard manure should be mixed with the soil while setting the plant. Several shovelfuls of manure placed around the tree after planting and worked well into the soil should prove beneficial.

Table 1—Recommended planting distances and number of plants required per acre of the common fruits.

Fruit	Recommended planting distances	No. plants required per acre (based on square system)
Pecans	60′ X 60′ to 80′ X 80′	12 to 7
Pome Fruits		
Apple	30′ X 30′ to 35′ X 35′	48 to 36
Pear	25′ X 25′ to 30′ X 30′	69 to 48
Stone Fruits		
Peach	20′ X 20′ to 25′ X 25′	108 to 69
Plum	20′ X 20′ to 22′ X 22′	108 to 90
Cherry	20′ X 20′ to 22′ X 22′	108 to 90
Figs	20′ X 20′ to 22′ X 22′	108 to 90
Jap. Persimmons	20′ X 20′ to 22′ X 22′	108 to 90
Grapes		
Bunch	8′ X 8′ to 10′ X 10′	680 to 435
Muscadines	Rows 10′ apart, plants 15′-20′ in row	290 to 218
Brambles		
Dewberry type	8′ X 8′ to 10′ X 10′	680 to 435
Blackberry type	Rows 10′ apart, plants 3′-4′ in row	1452 to 1089
Strawberries	Rows 3½′ apart, plants 18-24″ in row	8297 to 6223

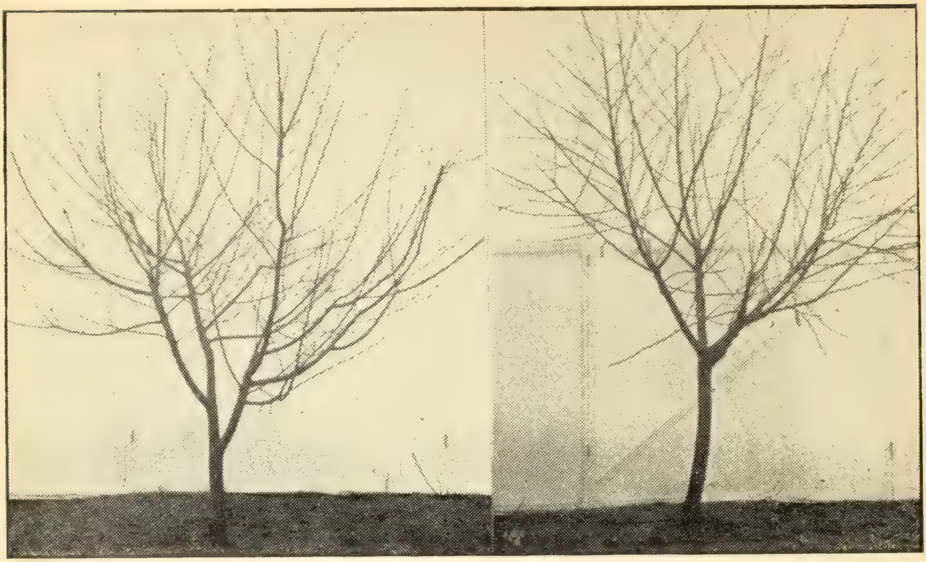

Figure 6. (Left) A 2-year old peach tree trained to the modified leader system (note that the scaffold limbs are spaced 6 to 8 inches apart). (Right) A 2-year-old peach tree trained to the open center system. All the scaffold limbs arise from the same point on the trunk of the tree.

Planting Distances

Such factors as varieties, growth habits, pruning practices, soil fertility and moisture content of the soil will determine largely the distance to set the plants. Plants which are lightly pruned and grown on good soil with an ample supply of moisture will grow much larger and require more space than those which are heavily pruned and grown on poor soil with a low moisture content. Table 1 lists the fruits, recommended planting distances, and number of plants required per acre for the common fruits.

Training and Pruning

Training may be defined as the removal of plant parts to influence the shape or form of the plant; while pruning is defined as the removal of plant parts to influence the function of the plant; that is, fruit production. In general, most of the training is done while the plant is young, to cause it to develop a definite form or shape. Pruning is done after the plant comes into bearing to encourage or promote fruit production.

TRAINING FRUIT TREES

One of two systems of training is generally used with tree fruits. These are the modified leader system and open center system, and are shown in figure 6. The system that more nearly approaches the natural growth habit of the tree under consideration should be chosen. Generally speaking, the modified leader system is associated with apple and pear trees, whereas the open center system is associated with peach and plum trees. Both methods will produce strong, well balanced, profitable trees if properly understood and maintained.

With the modified leader, three to five scaffold limbs (main branches arising from trunk) are spaced 6 to 8 inches apart vertically on the trunk of the 1-year-old tree. This spacing provides mechanical strength and usually insures a long-lived tree. With the open center, all scaffold branches, three being the preferred number, arise from within a comparatively short space on the trunk. By having only three scaffolds and these close

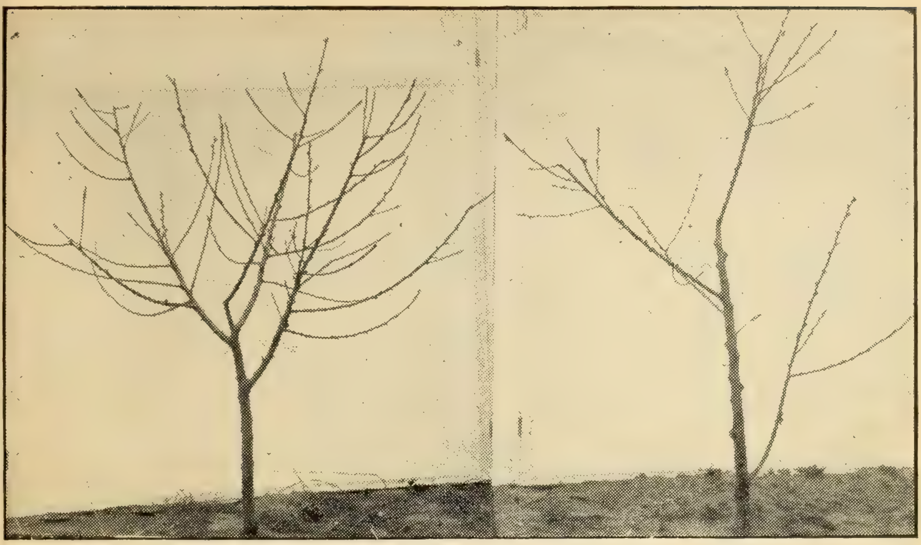

Figure 7. (Left) A 1-year-old peach tree after summer training was practiced. Note that the scaffold limbs are well developed and balanced. (Right) A 1-year-old peach tree that has received dormant training.

together they develop a knot-like head that will prove exceptionally strong against wind and heavy fruit loads.

Summer Training

Within recent years, summer training of fruit trees has received considerable

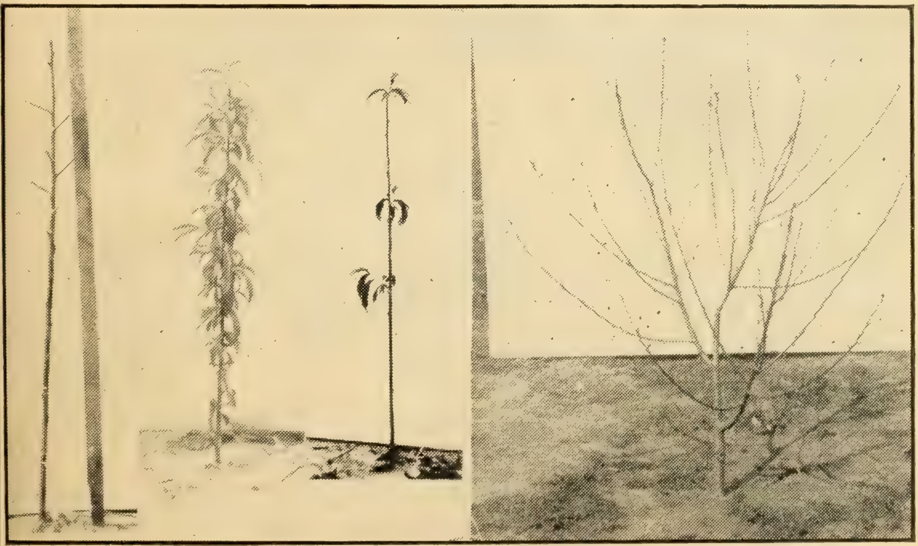

Figure 8. Showing the steps (from left to right) to follow in summer training a peach tree to the modified leader system from the time of setting the tree through the first dormant season. Three to five scaffold limbs should be selected in order to give a well-balanced tree.

attention from research workers. Summer training simply involves the selection of the main branches as well as other training details during the first summer following setting out in spring or previous fall, rather than waiting until the first winter or dormant period. Figure 7 shows value of summer training.

TRAINING PEACH TREES

The Modified Leader System

In summer training a peach tree to this system the tree should be cut back to about 32 to 36 inches at planting time and all lateral branches cut back to two buds. After the new growth has reached a length of from 4 to 6 inches, select from three to five well distributed scaffold branches, spaced 6 to 8 inches apart vertically, with wide strong crotches, as shown in figure 8. About 10 days to 2 weeks after the scaffold limbs have been selected, it will be necessary to go over the trees again and remove any superfluous shoots that have arisen since the selection of the scaffolds. When the scaffold limbs have reached a length of from 20 to 22 inches the terminal buds should be removed to encourage the formation of secondary scaffolds. By the end of the first growing season the primary shoots and a greater part of the secondary shoots should be formed.

Training during the first winter should consist of very light thinning of the secondary scaffolds (branches arising from primary or main scaffold limbs), and some heading of the main branches to outside lateral branches or buds. The number of necessary cuts at this season has been minimized as a result of the summer training program. If for some reason summer training was neglected then select the main scaffolds or framework branches, removing all other wood that might offer competition or interfere with the feature of the training system. The smaller inside branches of the

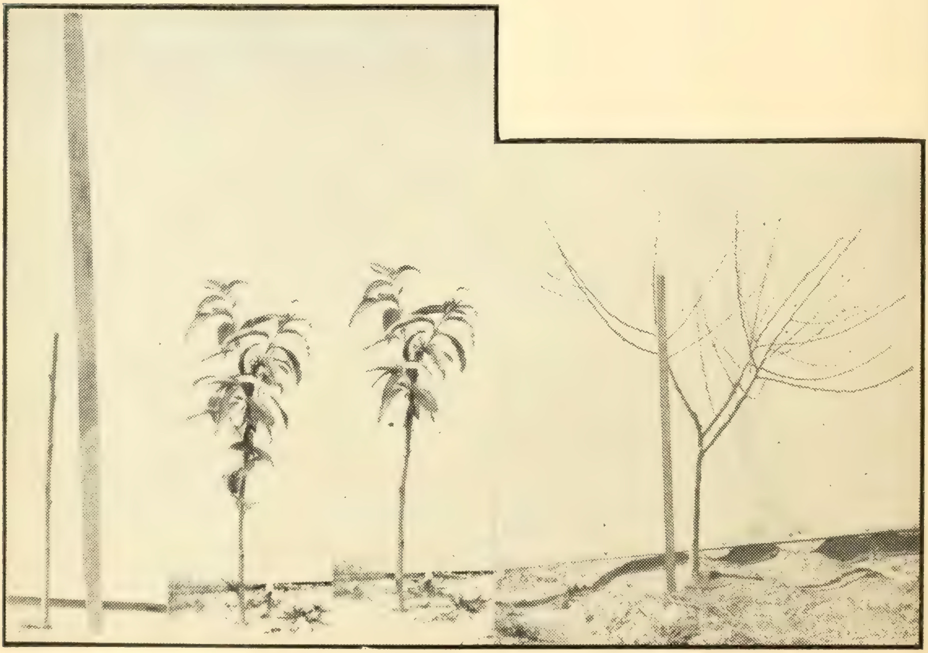

Figure 9. Illustrating the steps to follow in summer training a peach tree to the open center system from the time of setting the plant through the first dormant season.

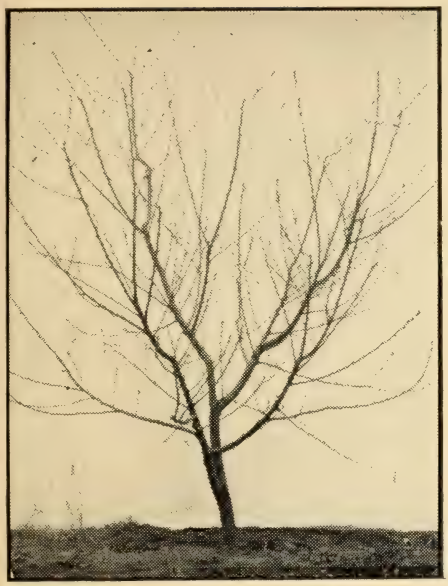

Figure 10. A 2-year-old peach tree which was summer trained, showing the necessary pruning which was done during the second dormant season. Note that the upright growing branches were cut back to shoots growing in an outward direction.

primary scaffolds should not be removed at this particular time as they will serve to shade the trunk of the tree, and also a great many of them will develop into fruiting shoots which will produce fruit the third year. Later on in the life of the tree as the top becomes more dense, these inside branches should be pruned out since they have served their purpose.

The Open Center System

The same procedure is followed in training the peach to the open center system as outlined above for the modified leader system except that the trees are cut back at planting time to 18 to 24 inches. This method encourages the development of low-headed, easily accessible individuals, since the three scaffolds, which should be well distributed around the tree, arise from practically the same point on the trunk. This point is commonly referred to as the head. Figure 9 illustrates the steps to follow.

Neither system requires much training during the second growing season. Cuts will be limited to a thinning out operation where branches are crowding and light heading back of main limbs to outside buds or lateral shoots. By the end of the second year, the framework of the tree should be largely completed, as illustrated in figure 10.

Training Other Tree Fruits

With few exceptions, the same general principles of training as outlined for peaches should be followed for the other common deciduous tree fruits (those that shed their leaves during the dormant season).

In the case of apples and pears, the modified leader system of training is recommended. Five to eight scaffold limbs should be selected instead of three to five as with peaches. This will necessitate cutting the tree back at planting time to 40 to 48 inches instead of 32 to 36 inches. Pears require very few cuts in their training other than the removal of crowding limbs during the first two or three seasons, which tend to come out from the head and grow at a sharp upright angle. Once the pear tree is properly shaped much less work is required than for an apple tree. One important reason for limiting the amount of training and pruning with pears is that they are subject to fireblight. Whenever any practice is used that promotes excessive vegetative growth, blight is accelerated.

Plums should receive the same treatment as peaches.

It must be kept in mind when selecting scaffold or main framework branches, irrespective of the kind of tree, the crotches should be sufficiently wide to insure mechanical strength; the branches should be spaced far enough apart to prevent crowding, since they become thicker as they grow older; and the main branches should be distributed as proportionately as possible on all sides of the trunk to avoid an unbalanced tree.

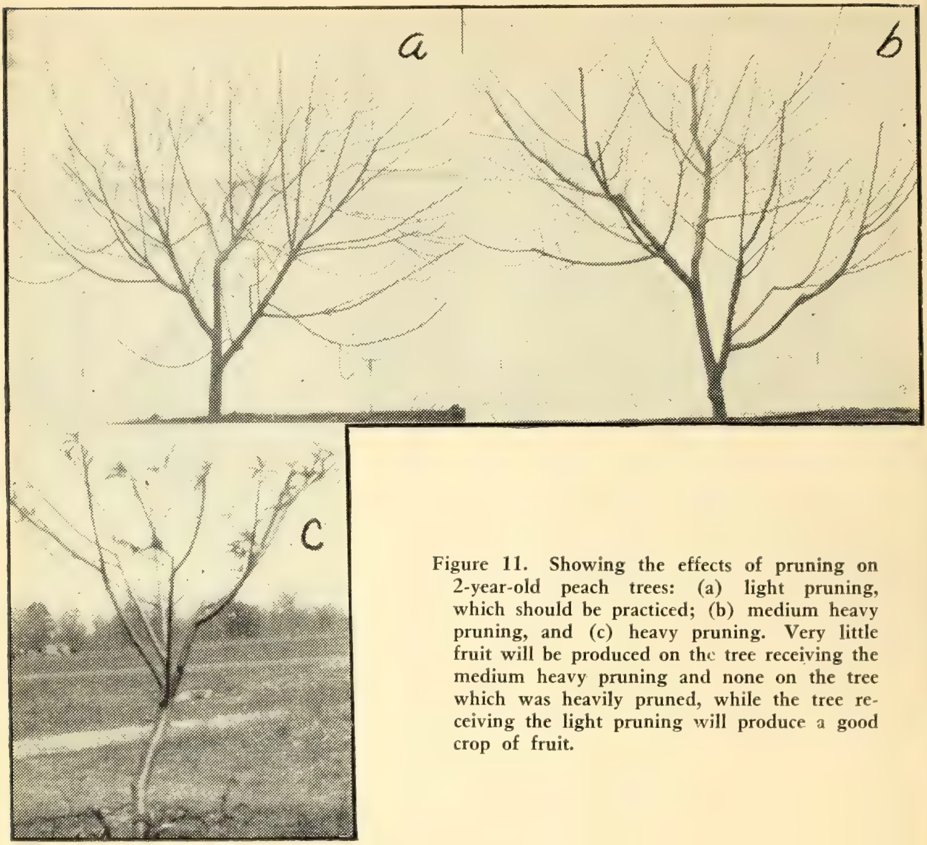

Figure 11. Showing the effects of pruning on 2-year-old peach trees: (a) light pruning, which should be practiced; (b) medium heavy pruning, and (c) heavy pruning. Very little fruit will be produced on the tree receiving the medium heavy pruning and none on the tree which was heavily pruned, while the tree receiving the light pruning will produce a good crop of fruit.

Pruning the Tree Fruits

Recent investigations have shown that larger trees and large crops of fruit are secured from much lighter pruning of trees than that formerly practiced (see figure 11). Pruning is a dwarfing process and therefore reduces the fruiting area and shortens the life of the tree. While the tree is young and capable of producing large crops of fruit the pruning should consist of a light thinning out of the branches, removing crossing and crowding shoots to permit uniform light distribution throughout the tree, and a light heading back of the larger branches to outside laterals to prevent the tree from becoming too tall, as shown in figure 12. As the tree becomes older the amount of pruning must be increased to stimulate the production of new shoots so that an adequate amount of fruiting wood will be present, and to maintain the desired height and width of the tree which will permit the most economical operation of the necessary orchard practices. This may be accomplished by a moderate thinning out of branches and by cutting back occasionally into the older wood, always cutting to an outside lateral branch.

Thinning and Heading

Thinning consists of the removal of an entire shoot, while heading consists of the removal of only a portion of a shoot. In the deciduous tree fruits most of the stored food is in the terminal portions of the shoot. Therefore, thinning equally

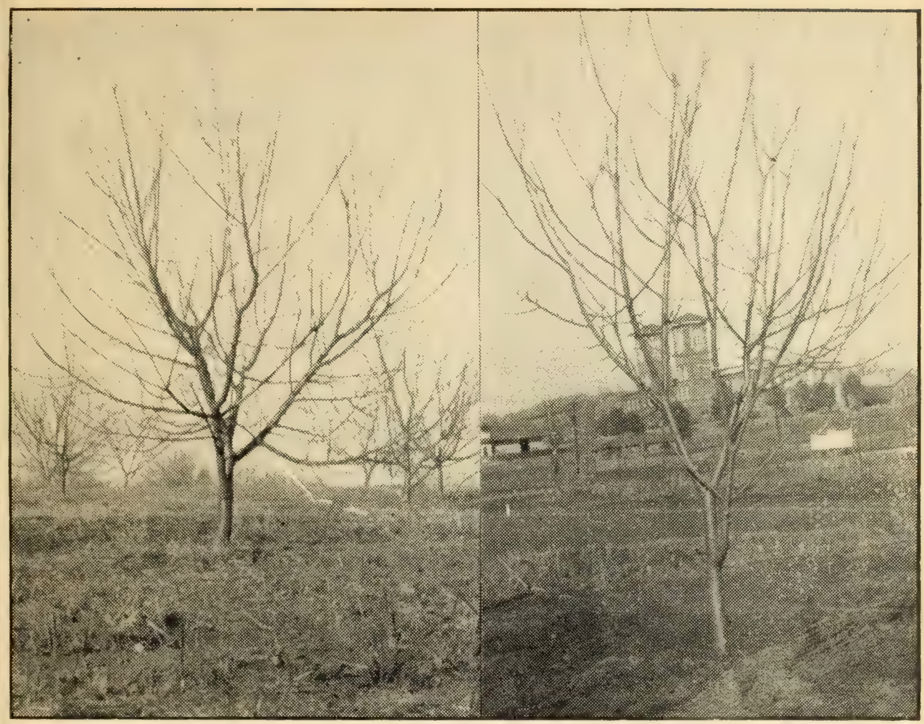

Figure 12. (Left) A 4-year-old peach tree and (right) a 5-year-old apple tree both of which have received light pruning. Note that the branches have been cut back lightly each year to outside lateral branches.

severe (in weight or length) removes less stored food and is less devitalizing on the plant than is heading. Thinned trees make normal growth, store up food normally and produce numerous fruit buds and spurs, whereas, headed trees tend to grow late in the season, have bushy tops, and produce fewer fruit buds and fruit spurs. Heading disturbs the equilibrium in the tree, changing its tendency from fruitfulness to vegetativeness, and should not be practiced except in training trees or to keep them in bounds.

When cutting off an entire branch or limb, either by means of the saw or shears, a good smooth job should be done. It is never considered first class pruning to leave stubs because they never heal over properly and will invariably become infected by a wood rot which often works its way back down the stub into the main body of the tree. Always remove the branch as close to the point where it originates as possible so there will be no stub.

Painting pruning wounds is generally omitted because untreated wounds have shown a remarkable degree of recovery and numerous small cuts are preferred to a few large ones. If the removal of a large limb becomes a requirement, exposing an area 2 or more inches in diameter, it could be covered by a wound dressing such as Bordeaux paste, common paint, white lead, grafting wax, or any of the various proprietary tree painting compounds, most of which possess an asphalt base.

Season of pruning. In general all pruning should be done during the dormant season. Summer pruning may be done to an advantage in training young trees and to remove water sprouts to conserve moisture and nutrients.

Renewal pruning. Many fruit trees, especially peaches, become devitalized through neglect. Such peach trees have scaffold limbs 15 to 20 feet long and normally produce shoots of from 1 to 3 inches in length in the extreme top and outside of the tree, with an extensive area in the center of the tree producing no fruit. In many cases, trees of this type may be made productive again by heading the scaffold limbs back during the dormant season to a length of 6 to 8 feet and the remaining lateral limbs to a length of 2 to 3 feet. An abundance of new shoots with a good supply of fruit buds will be produced from these cut back limbs. During the following dormant season the pruning should consist of a moderate thinning out of the new shoots and the stronger shoots headed back to outside lateral branches. Thereafter, light pruning should be followed.

Figure 13 illustrates a 17-year old Hiley peach tree 5 years after renewal pruning was done.

Grape Training and Pruning

Both training and pruning of grapes are usually thought of as pruning, but because there are a number of training systems the two should be distinguished. Training has to do with the establishment of the body of the vine to insure a good distribution of its parts to facilitate such operations as spraying, cultivation, pruning, and harvesting. Pruning is concerned with production, and controls total yield and the size and quality of the fruit of the plant.

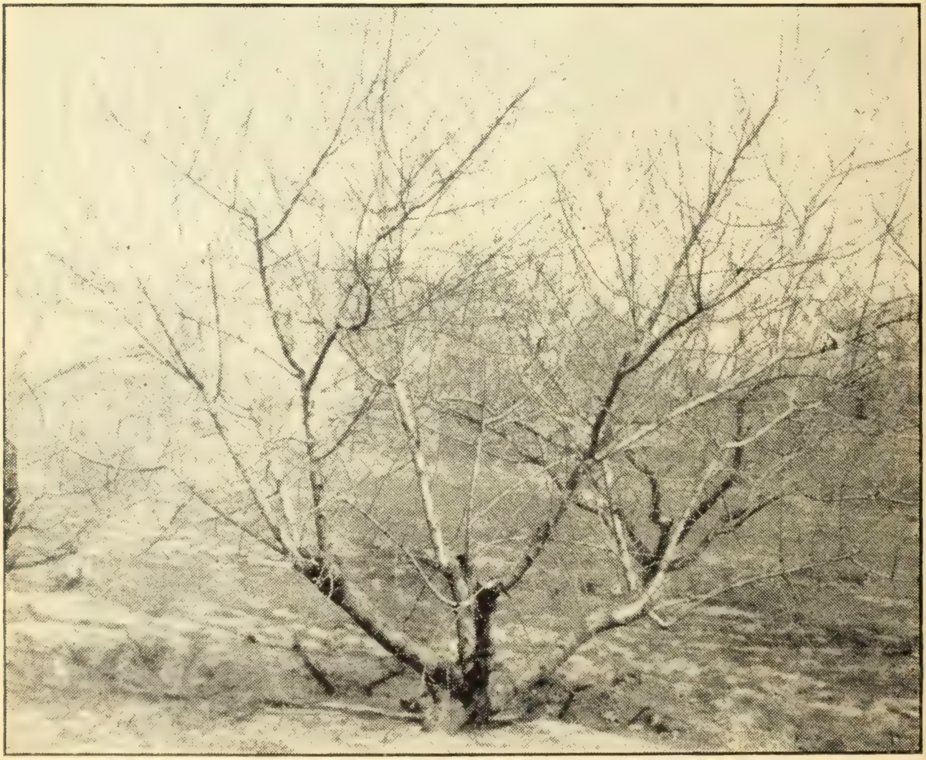

Figure 13. A 17-year-old Hiley peach tree 5 years after dehorning was done. Note that the secondary frame work has been completely rebuilt.

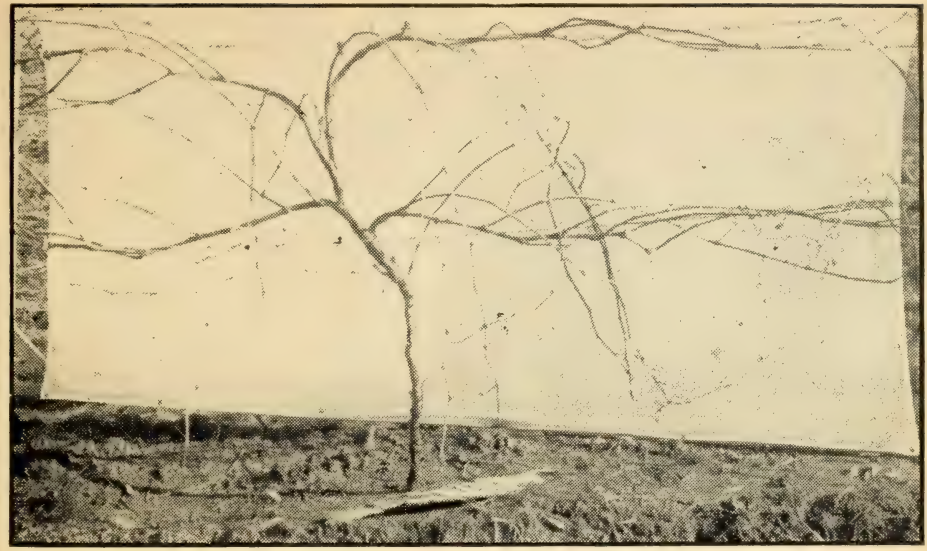

Figure 14. A grape plant trained to the four-cane Kniffin system (before pruning).

Grapes should be pruned during the dormant season, with December probably being the best month, since the plants are usually completely dormant at this time and less bleeding is likely to occur.

Bunch Grapes

Any one of several systems of training bunch grapes may be used. Since the four-cane Kniffin system is easy to establish, and provides ample support for

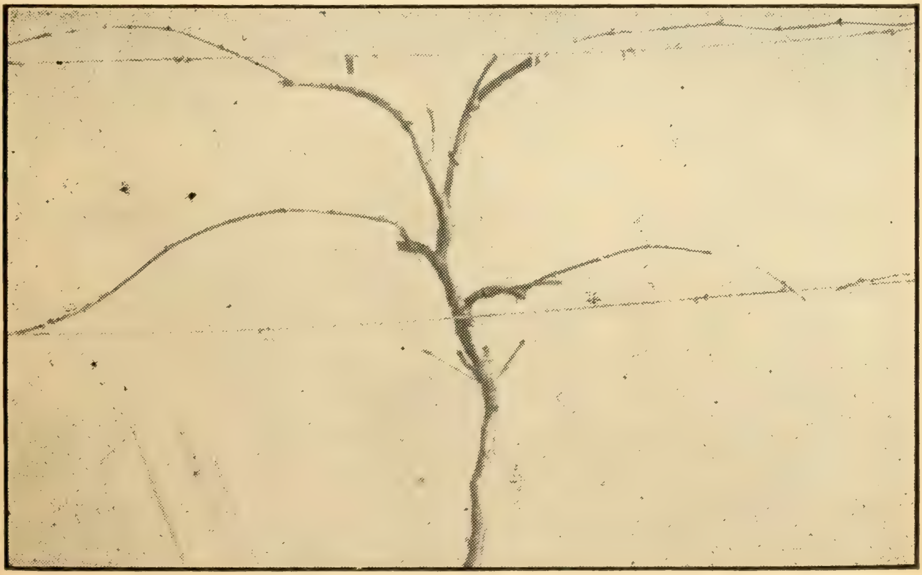

Figure 15. The same grape plant as figure 14, after pruning.

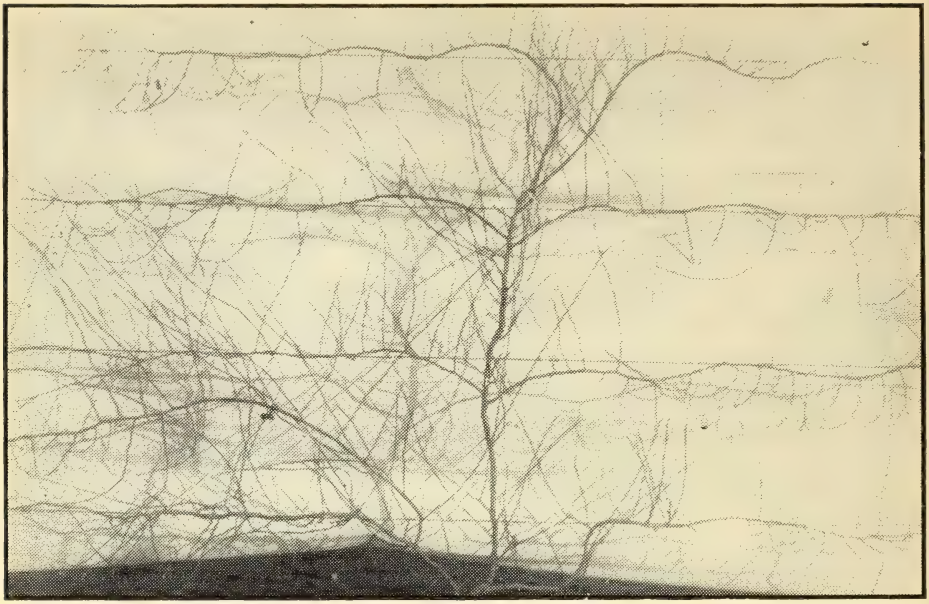

Figure 16. A muscadine plant trained to the eight-cane Kniffin system (before pruning).

the plants, it is described here. To establish this system, set posts at 20-foot intervals in the row, letting them extend at least 4 feet above the ground. Stretch two strands of No. 9 wire, the lower one 30 inches above the ground and the upper one 18 inches above the lower one, on the post to form a trellis.

When the plants are set out, cut them back to two buds. After growth starts in the spring the weaker of the two shoots should be removed, leaving the stronger one to form the trunk of the plant. At the end of the first growing season tie the cane in an upright position to the two wires, cutting it back if necessary at the top wire. At the end of the second growing season select four canes, two to the right (one on each wire) and two to the left of the trunk, and cut them back to 8 to 10 buds and tie them to the wires.

The amount to prune a grape plant will be determined by such factors as age, variety, and vigor of vine. Such strong growing varieties as Concord and Niagara are not pruned as much as weaker growing varieties such as Delaware and Catawba. In pruning it must be borne in mind that the fruit is produced from buds on the 1-year-old wood. Therefore, select four well-developed medium-sized 1-year-old canes, two to the right, and two to the left of the trunk to produce the next season's crop. On the stronger growing plants cut these four canes back to 10 to 15 buds each and on the weaker plants cut them back to 8 to 10 buds each. All other growth should be removed except that some of the other 1-year-old canes on the trunk may be cut back to two buds, as they may be needed to produce canes for the following year's crop. Figures 14 and 15 show a bunch grape plant before and after pruning.

Muscadine Grapes

The growth and fruiting habits of the muscadine grape are different from those of the bunch grape. For these reasons the training and pruning are different. The training is the same as for the bunch grape except that 3 or 4 wires are necessary to form the trellis. This, of course,

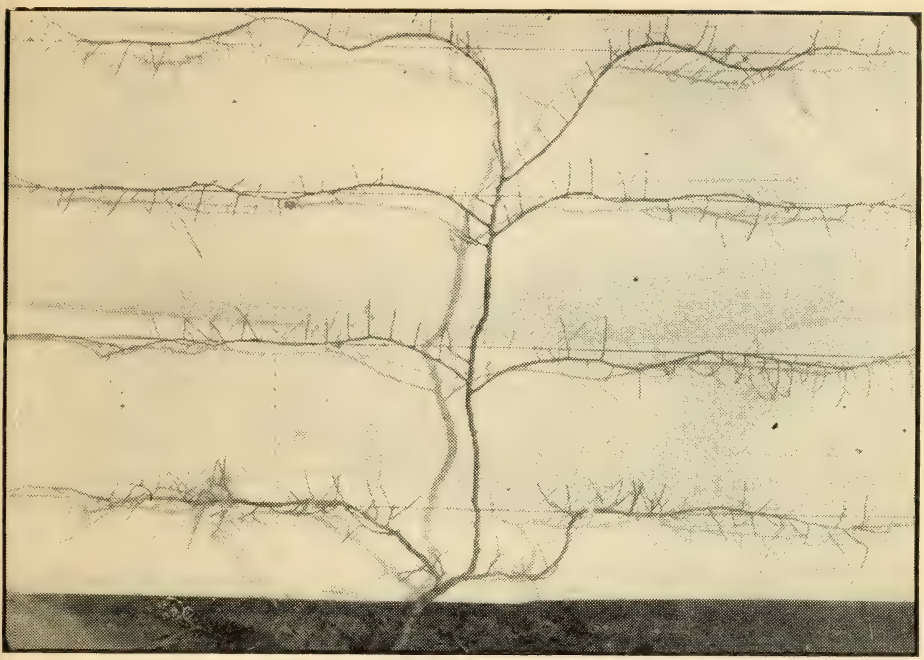

Figure 17. The same muscadine plant as that shown in figure 19 after being pruned. Note that all the new growth was cut back to two to four buds.

necessitates longer posts as the wires are spaced about 18 inches apart. In the case of the muscadine the canes (arms) on the trellis are permanent and do not have to be renewed each year. Furthermore, they are cut back to a length of

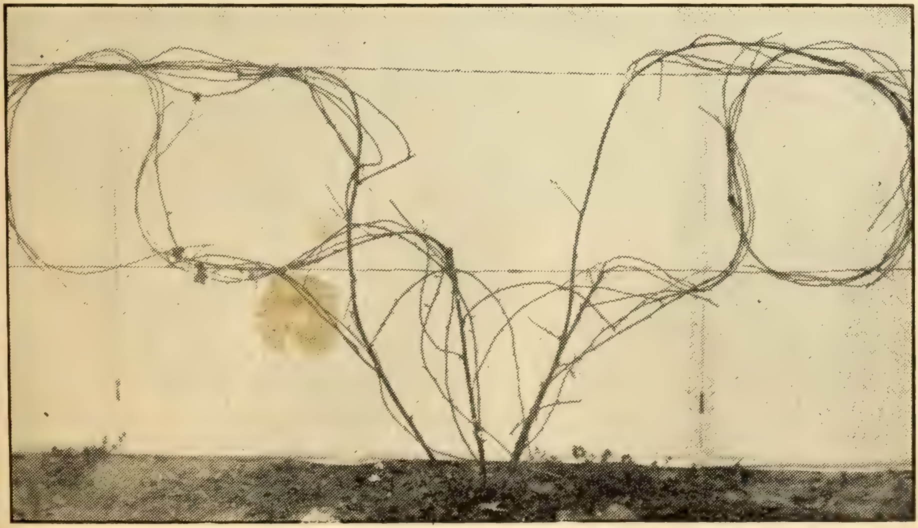

Figure 18. A Boysenberry plant trained to the 2-wire vertical trellis.

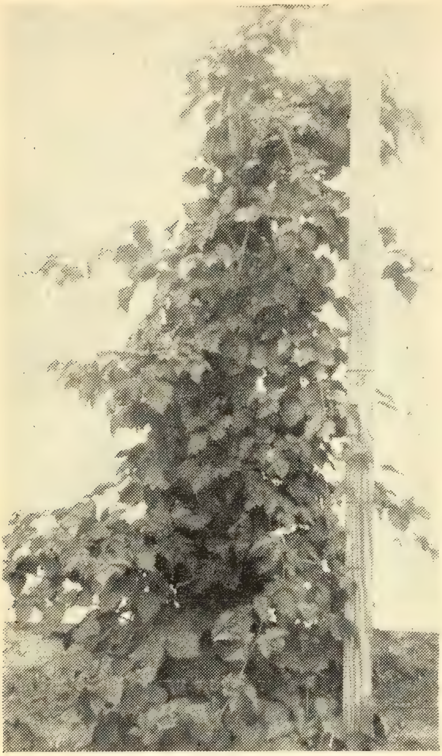

Figure 19. A Boysenberry plant trained to a stake.

from 4 to 6 feet. After the frame work of the plant is established the pruning consists of the cutting back of all the 1-year-old wood to two to four buds. Figures 16 and 17 illustrate a muscadine plant trained to the eight-cane Kniffin system before and after being pruned.

Training and Pruning Brambles

The brambles include blackberries, dewberries, raspberries, Youngberries, and Boysenberries. Raspberries are not successfully grown in Mississippi. Blackberries and dewberries grow in such profusion in the wild state in most sections of the State that they are seldom grown under cultivation. For these reasons only the hybrid varieties, Youngberries and Boysenberries, are included in this discussion.

Both the Youngberry and Boysenberry have a trailing type of growth, which necessitates some form of support for the canes if the best fruit is to be obtained. The support may be in the form of a single stake, two-wire vertical trellis, or two-wire horizontal trellis as shown in figures 18 and 19. When the stake system is used, the stake should extend above the ground 4 to 5 feet. The two-wire vertical trellis is identical with that described for bunch grapes and the two-wire horizontal trellis is made by stretching two wires 24 inches apart and 30 inches from the ground, with the supports set 20 feet apart in the row.

Youngberries and Boysenberries grow canes one year, and these produce fruit the second year. Therefore, during the second season and thereafter the plants will be producing fruit from 1-year-old

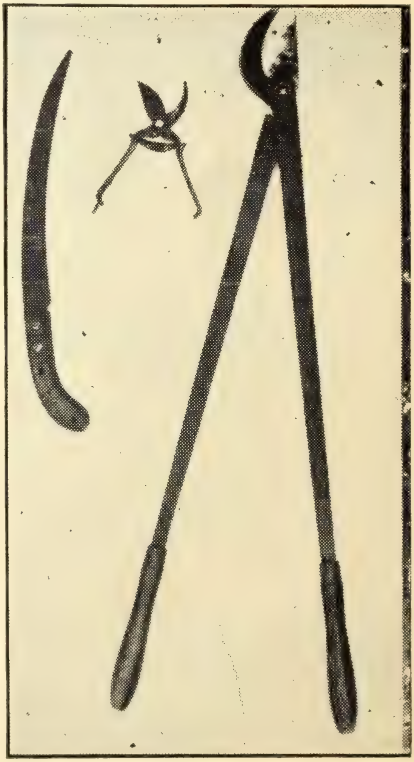

Figure 20. From left to right, curved saw, hand shears, long-handled shears or "loppers" and step ladder.

canes and at the same time growing new canes from the crown of the plants for the crop the following year. As soon as the fruiting season is over all the old fruiting canes should be removed and burned, leaving only the new growth. In the southern part of the State the practice is quite often to remove the old and new canes and burn them in order to destroy diseases and insects. This practice is questionable in the northern part of the State where the ripening season is later, thereby reducing the length of time to produce the second crop of new shoots for the fruit crop the following year.

Pruning Equipment

It is impossible to do efficient pruning unless good pruning equipment is available. With the wide variety of makes, sizes, and shapes of pruning tools obtainable it is sometimes difficult for the inexperienced orchardist to make a wise selection of pruning equipment. Figure 20 illustrates a curved saw, hand shears, and long-handled shears or "lopper." All this equipment is not necessary while the plants are young. At this time most of the pruning may be accomplished with only the hand shears. As the trees become older and increase in size it will be necessary to use the saw and long-handled shears to remove larger limbs.

ORCHARD SOIL MANAGEMENT AND FERTILIZATION

Fruit crops, as do other crops, require good soil management and fertilization in order to produce large crops of high quality fruit. Productive fruit trees may be characterized by an abundance of large dark green leaves, shoot growth of good length and thickness, healthy tree trunks and scaffold limbs, and an adequate supply of well developed fruit buds and fruit spurs.

Systems of Soil Management

Strip Cultivation

By this system of culture a portion of the area between the tree rows is cultivated, leaving the remaining area to grow a cover for the protection of the soil. While the trees are young, especially with peaches, it is better to cultivate that area immediately adjacent to the trees,

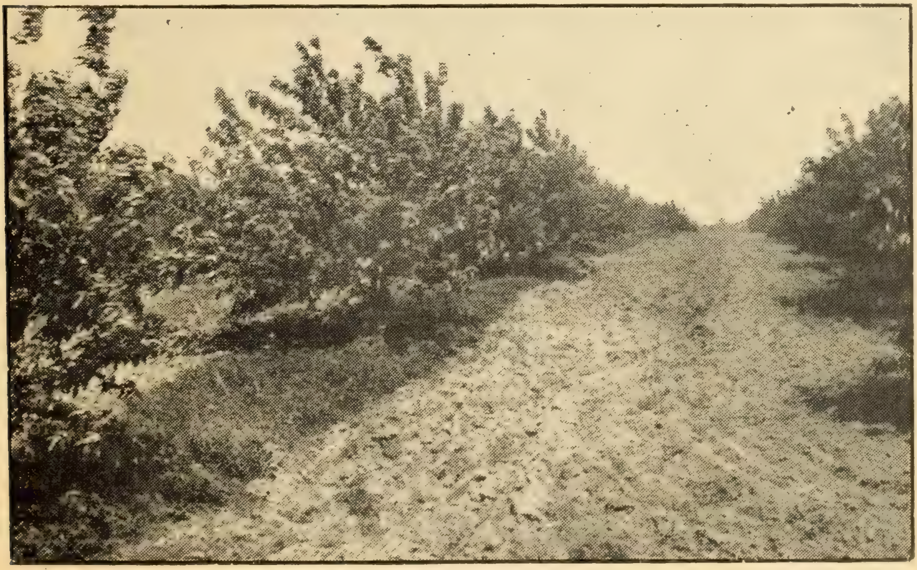

Figure 21. A system of strip cultivation may be used to an advantage in the orchard especially on rolling land.

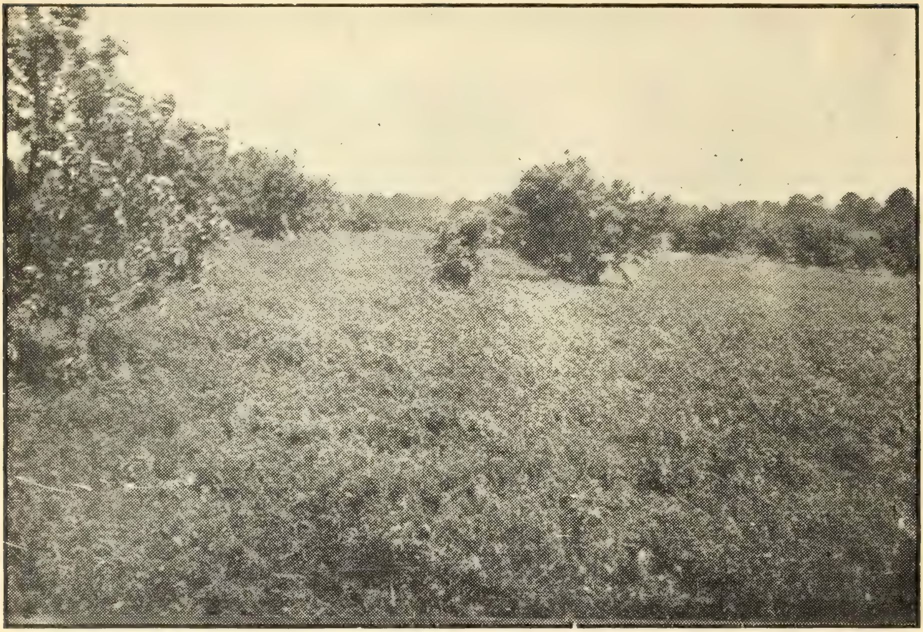

Figure 22. Hairy vetch makes an ideal winter cover crop in some sections of the State. Other legume cover crops are equally as good in other sections.

leaving an area between the tree rows 8 to 10 feet wide to grow the cover crop. After the trees come into production and are well established it is better to leave that area adjacent to the trees uncultivated, as shown in figure 21. If such cover crops as bur clover or vetch are used they will often produce enough seeds on the uncultivated area to grow a good cover the following year. Grass and weeds should be controlled by the use of a mowing machine.

A system of strip cultivation on rolling land and where the trees are planted on the contour offers the distinct advantage of controlling to a great extent the erosion of the soil. Furthermore, the use of legume cover crops will add nitrogen to the soil and organic matter will be added, which will increase the water holding capacity of the soil.

Clean Cultivation with Cover Crops

On level land, a system of clean culture throughout the growing season with a winter cover crop sown in the fall to be turned under the following spring may be used to an advantage. By such a system all grass and weeds are destroyed, thus reducing to a minimum the competition for moisture and plant foods during the summer months. In addition, legume cover crops, when turned under, will add nitrogen and organic matter to the soil. Figure 22 illustrates a crop of vetch just before turning under.

Intercropping

During the early life of the orchard while the trees are small and do not need all the space, such cultivated crops as beans, tomatoes, Irish potatoes, cabbage, or any other low growing crop may be grown between the tree rows to supplement the income from the orchard until the trees come into bearing. Where such practices are followed it is important that ample space be left on either side of the trees to protect them. The tree rows should be cultivated along with the crop grown. With this system a winter cover crop may be sown in the fall to be turned under the following spring.

Mulching

The practice of mulching around fruit trees, both young and old ones, has gained many followers during the past several years. Any kind of material may be used to mulch with; however, coarse materials such as corn stalks and shavings are likely to accentuate insect problems. Mulching is accomplished by placing some organic cover or litter, leaves, grass, cottonseed hulls, straw, hay, pine needles, etc. on the ground underneath and beyond the spread of the branches. The amount should be sufficient to control weed growth. In addition to eliminating weeds and thereby conserving moisture, a mulch reduces surface evaporation, checks erosion, enhances rainfall penetration, and reduces rapid oxidation of organic matter in the soil. If a mulching program is followed, extra nitrogen fertilizer must be added to offset early loss of nitrogen which is utilized in the gradual decomposition of the mulch material. It will therefore be necessary to add small additional amounts of mulch each year. This system of soil management may result in certain hazards each year, especially fire, field mice, and insects.

Sod Culture

In areas occupied by pear trees or in mature apple orchards a permanent cover or sod may be maintained and considered good soil management, particularly on land subject to erosion and where soil moisture is not a limiting factor. Apples and pears root deeper than peaches and plums; therefore, they are not in such constant conflict with the soil cover for water. If, however, it becomes feasible during a dry period in the spring or summer to remove competition between the fruit trees and the sod, the latter may be mowed or lightly disked. Another reason for considering this system in pear orchards is to escape as far as possible the occurrence of fireblight, which is a disease very serious on most pear varieties grown in the South. The development of this disease is encouraged by any orchard practice promoting the growth of an abundance of tender succulent wood.

Orchard Fertilization

The amount and kind of fertilizer to apply to fruit trees will be determined by such factors as age, vigor and kind of trees, kind of soil, and production records. Trees which are making little growth, producing few fruits, and having small yellow leaves will need heavier applications of fertilizer than those making good growth, producing large crops of fruit, and having large green leaves.

Because each orchard presents a different problem it is impossible to state specific recommendations as to the amount and kind of fertilizer to use. Therefore, the suggestions given should be modified to meet the individual requirements.

Apples

Bearing apple trees should make an average yearly terminal growth of from 8 to 12 inches and young non-bearing trees a growth of 16 to 30 inches. In general, annual application of from ¼ pound to ½ pound of some nitrogen carrying fertilizer such as nitrate of soda or sulphate of ammonia for each year of age of the tree is sufficient; a 12-year-old tree would require 3 to 6 pounds of nitrate of soda. The maximum amount recommended in any case should not exceed 8 to 10 pounds for a full grown apple tree. Where trees are in a poor state of vigor and cover crops making a weak growth, 5 to 8 pounds of a complete fertilizer on 10- to 12-year-old trees in addition to the nitrogen should prove beneficial. The amount can be increased or decreased as determined by the age and vigor of the tree. A widely accepted method of applying a complete fertilizer is to broadcast over the entire area rather than just beneath the spread of the branches. By so doing, cover crops will be more directly benefited. Where nitrogen alone is added, it is recommended that the fertilizer be broadcast around the trees and extending slightly beyond the spread of the branches. Apparently fertilizers for apple trees can be applied to best advantage about 2 or 3 weeks before full bloom.

Peaches and Plums

Enough fertilizer should be applied to these fruits to cause a terminal growth of 12 to 24 inches. From 1/6 to ¼ pound of some nitrogenous fertilizer for each year of the tree's age should be adequate to provide the necessary fruiting surface for desirable annual crops. On poorer soils, 4 to 6 pounds of a complete fertilizer should be used in addition to the above recommendation. Since stone fruits are frequently planted on lighter soils, it may be advisable to make two applications of the nitrogen-carrying fertilizer. If this practice is followed, it will perhaps reduce leaching of fertilizer, increase fruit set as well as favor fruit bud formation for the succeeding fruit crop. The first, consisting of two-thirds the total amount, should be applied 10 days to 2 weeks before the blossom buds show pink and the second, consisting of the remaining one-third, immediately after the fruit is harvested. The method of application is the same as that for apples. In distributing fertilizer materials on fully mature fruit trees, it is needless to come within 2 feet of the trunk inasmuch as there are few if any feeder roots that close to the trunk of the tree.

Pears

Where the pears are growing in sod they should receive small amounts of quickly available nitrogen-carrying fertilizer, such as nitrate of soda, about one month before growth starts. This will aid in the setting of fruit and promote early vegetative growth. Later in the season the grass sod will check growth of the trees and encourage hardening of the wood, thus making the trees more resistant to fire blight. In cultivated orchards it is doubtful that any fertilizer should be applied to pears.

Grapes and Brambles

On most soils grapes and brambles should receive applications of a complete fertilizer which is high in nitrogen, such as 6-8-4. Usually 2 to 3 pounds per plant per year applied in two applications as with peaches is sufficient.

Fruit Thinning

Fruit thinning is the removal of a portion of the fruit crop in order that maximum yields of high quality fruit may be secured. It is a recognized orchard practice among the better fruit growers, and if good fruit is to be produced, the thinning operation is as indispensable as pruning, spraying, and soil fertilization.

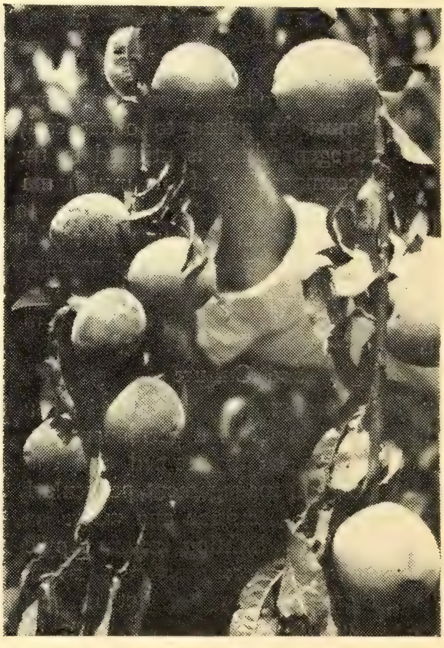

Figure 23. Showing the effect of thinning on size of fruit. The fruits on the thinned trees (on right) are larger and of more uniform size and color. Note the curculio damage to the fruit on the extreme upper left of the unthinned branch, held beside the thinned fruit for comparison. Such fruits should be removed during the thinning operation.

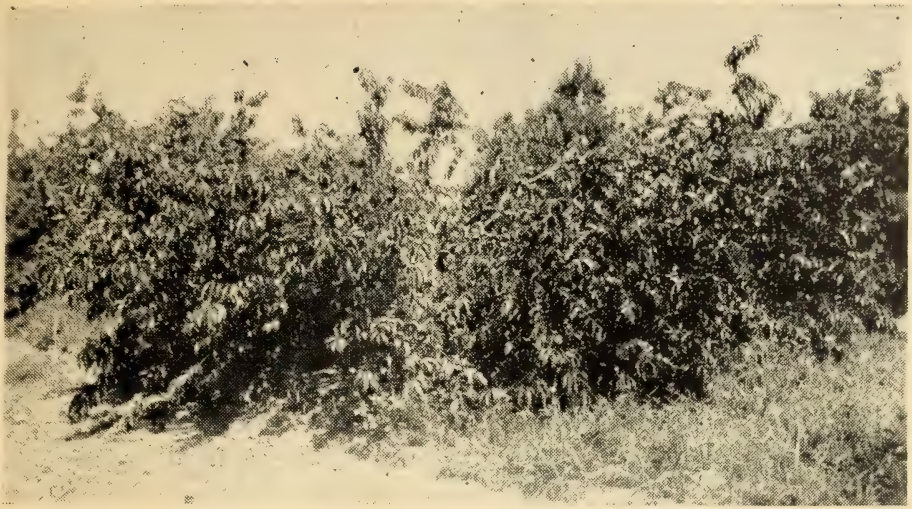

Figure 24. This peach tree is so heavily loaded with fruit that it has caused the upper limbs to bend down and completely cover the lower ones. This would not have occurred had the fruit been properly thinned.

Systematic thinning will result in fruits of larger size with more color, quality and uniformity, prevent the breaking of limbs, aid in the control of insects and diseases, reduce handling costs at harvest time, and help maintain the vigor of the trees.

Effect of thinning on size, color, quality and uniformity of fruit. The greatest advantage resulting from fruit thinning is the increased size secured. (See figure 23.) With the removal of a portion of the crop from the tree, more nutrients are available per fruit for the remaining fruits. When thinning is properly done the increase in size of the remaining fruits will offset the decrease in the number of fruits, so that no decrease in yield will result.

Most fruits, such as apples, peaches, and plums, require sunlight for the development of the red color. By removing the fruits from the densely shaded portions of the tree the remaining fruits are exposed to more sunlight. Furthermore, heavily loaded branches which are properly thinned will assume a normal position, thereby preventing the lower branches from becoming shaded. Figure 24 illustrates a peach tree so heavily loaded with fruit that the upper limbs have completely covered the lower ones, and are thus preventing the sunlight from reaching the fruit.

Effect on limb breakage. It is not uncommon in years of a heavy crop for a fruit tree to produce so much fruit that it causes the limbs to break. This damage is often such that the tree is permanently ruined. Figure 25 shows a young tree which is damaged beyond repair as a result of poor training, too much fruit, and a high wind. Proper thinning would have greatly reduced the load of fruit on this tree and probably prevented the damage.

Effect on disease and insect injury. During the thinning operation, all diseased and insect-injured fruit should be removed so that none of it is present at harvest time to increase the cull pile. The removal and destruction of injured fruit helps to control insects and diseases. It also permits a better coverage of spray

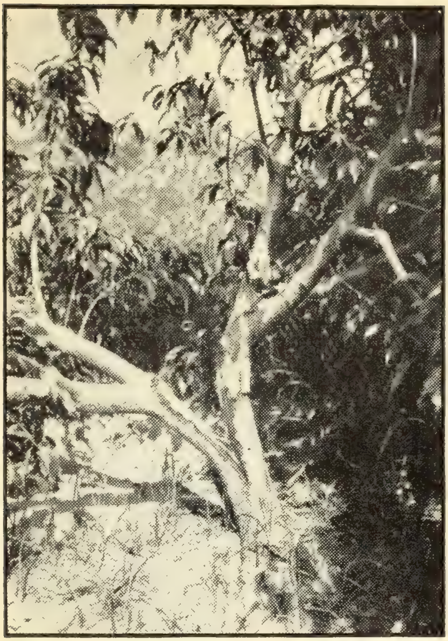

Figure 25. This young peach tree damaged beyond repair, as a result of poor training, an overload of fruit, and a high wind.

materials, further aiding in disease and insect control.

Effect on harvest costs. Since the fruits on the thinned trees will be of greater average size than those on the unthinned trees, it will require less time to harvest any definite amount of fruit from the thinned trees, thereby reducing the harvesting and handling costs per bushel of fruit.

Effect on vigor of trees. The production of a heavy crop of fruit will deplete the food reserves of the tree and quite often result in a light crop the following year. In order to maintain the vigor of the tree, large crops of small fruits should not be allowed to mature. It requires practicaly as much food material to produce the seed in a small peach as that in a large peach, and if the tree is allowed to mature large crops of small fruits it will soon become devitalized and unproductive.

Time of Thinning

Fruit thinning should be done as soon after the final drop as possible, which is usually about 6 to 8 weeks after full bloom. At this time the fruits of the peach will be about three-fourths inch in diameter, and those of the apple about 1 inch in diameter. Early thinning is highly desirable because it will conserve the nutrients that go into the development of the fruits and is therefore less devitalizing on the plant than is late thinning.

Method and Amount of Thinning

Thinning of the fruit should be done by hand. Shears and similar small tools require more time than hand thinning, and there is the added hazard of injury to the fruit that is to be left on the tree. All small, deformed fruit, and all insect or disease injured fruit should be removed.

The amount to thin will depend largely on the kind of fruit and the vigor of the tree. Fruits on peach trees of average vigor are usually thinned to an average of 4 to 6 inches apart, plums 2 to 4 inches apart, apricots far enough apart so that they will not touch when ripe, apples and pears 6 to 8 inches apart, with one fruit per cluster on the older trees and two fruits per cluster on the young vigorous trees. Such fruits as grapes and brambles are thinned by the usual dormant pruning operation, when much of the wood is removed, as it is not economically feasible to remove the individual fruits or even fruit clusters.

Propagation

For information on the subject of propagating fruits of the home orchard, write for Mississippi Experiment Station Bulletin No. 375.

FIGS, PECANS, AND STRAWBERRIES

These fruits have been purposely omitted from the discussion on account of their adaptability to plantings outside a specified plot for the home orchard. Although strawberries fit in nicely in the perennial section of a vegetable garden, these fruits should be planted wherever a better job of management can be maintained. In the case of figs and pecans, it is very desirable to set them out near the house or other farm buildings. Figs seem to do better when planted on the north side of a farm building and close enough so that the roots can run under the building. Pecans are valuable both as a nut and as a shade tree. This dual purpose plant should be utilized in landscaping the farmstead rather than planting it in a home orchard. A pecan tree feeds widely and occupies a lot of space that could be used by fruit trees more economically.

Figs

Figs do not require as careful attention as tree fruits for high quality production. The plants are generally trained to bush form. All the pruning necessary is to keep the bush growth from becoming too thick, removal of dead wood, and to keep the shoots within bounds to facilitate harvesting. If fertilizer is needed to encourage the growth and production of the plants, 3 to 5 pounds of complete fertilizer per bush or a reasonable application of some form of manure may be added. Cultivation is to be discouraged especially deep tillage because the great mass of feeding roots are found near the soil surface. Furthermore, cultivation tends to aggravate the nematode problem which is a serious pest on fig roots.

Pecans

Strong healthy nursery stock, 4 to 6 feet tall, with a well-developed taproot should be used for planting. Only limited effort is expended in training the trees. Main scafford limbs with a narrow angle or crotch are inherently weak, and under a heavy load of fruit or in a strong wind are liable to injury or complete destruction in later years, so they should be removed. Dead wood and crowded branches should be cut out. Pecans require no more care than any other well-groomed shade tree.

Moderate applications of fertilizer, particularly a nitrogenous material, is encouraged under most conditions. Vigor of the tree and fruitfulness are good indicators of its fertilizer needs. Time and method of application are similar to peach and apple recommendations.

The pecan, as with other economic plants, is attacked by diseases and insects. For a complete pecan spray schedule, see Mississippi Extension Circular 114. The difficulty of spraying full grown pecan trees with small orchard equipment is appreciated, so the sanitation aspects of control are stressed in checking diseases and the shuck worm. Using varieties such as Stuart and Moore that carry some resistance to scab, is a practical combat measure.

A few of the many so-called papershell varieties, other than Stuart and Moore, that may be found planted over the State are Success, Moneymaker, and Schley.

Strawberries

This early fruit should be grown more widely in Mississippi home gardens. From a dietary viewpoint, strawberries are high in vitamin C and as a frozen fruit, it is one of the best.

Planting. Strawberries are set out in rows about 3½ feet apart with the plants 18 to 24 inches apart in the row. The land should be well prepared prior to planting. In general, rows are bedded up slightly and plants are allowed to make a matted row. The terms "matted row" and "hill" are indicative of the management methods. In the former, runner plants originating from the mother plants are permitted to take root and thereby form more or less a solid row of plants; under the latter method, runner plants are kept cut off so there is a plant to the hill. Spring setting of plants where the matted row system has been adopted, is preferable to fall setting. In the lower part of the State where the hill system is popular, late fall is the best time to set out. Under hill-type management, plants should be set about 12 inches

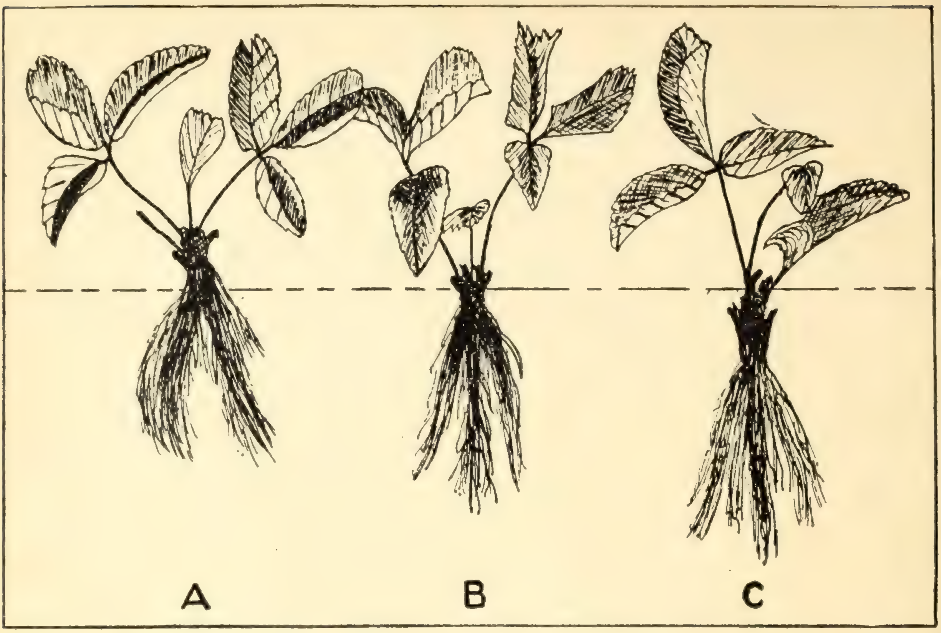

Figure 26. Depths of setting plants: A—Too shallow; B—Correct depth; C—Too deep.

apart in the row. Spring set plants to the matted row system are not encouraged to bear until one year later because energy is directed the first growing season toward plant production rather than fruit production. Strawberries set in the fall according to the hill system, will bear fruit the following spring. They are then plowed up and new plants set out again in the fall which makes strawberry growing under this plan an annual proposition.

New plants, irrespective of where purchased or dug, should be healthy, strong, one-year-old individuals. When setting plants, the crown should be level with the ground. Correct location of the crown is very important as well as spreading out the roots in the hole rather than cramping them in a small space. See figure 26.

Cultivation. Strawberries will require cultivation the same as any other row crop. As a matter of fact, some hand weeding will be necessary. The very nature of strawberries prevents their successful competition with hardy weeds. The frequency of cultivations will depend upon the weed population of the area set to strawberries, season, soil type, and whether or not a mulching program is pursued. Some growers will stir the soil lightly soon after planting to overcome soil packing that may have occurred during the planting operation.

Spacing. Newly formed plants should be spaced in the matted row at the end of the growing season. In the light of present knowledge, this practice seems advisable. An excess of plants per square foot of row does not mean increased production since each individual plant must have adequate soil space for maximum performance. Space between thinned plants should be about the width of a hoe. In removing plants, take out the weak poorly-developed ones. If plants in the matted row begin to spread out beyond 18 to 20 inches, limit the row's width by hoeing or plowing both sides.

Fertilizing. While the soil is being prepared and just before setting the plants, applications of from 200 to 400 pounds of a complete fertilizer such as 6-8-4 should be made per acre, or from about 2 to 3 pounds per 100 feet of row. The following September a like amount of complete fertilizer should be applied to stimulate fruit bud formation, and a third application of from 300 to 400 pounds per acre should be made in January to stimulate vegetative growth and to increase the fruit set.

Renovation. This term simply means the rows are partially plowed up, plants and all, and put back in shape or renewed in preparation for newly formed plants that will come on during late spring and summer. As soon as the first harvest is over, about half of the old plants should be plowed up by either plowing a strip off each side of the row or half of one side only, depending on the plant population and distribution over the bed. This operation provides a good time for applying fertilizer as it can be broadcast over the plowed portion of the row and worked in as the plowed area is worked back toward the strip of unmolested plants. The newly conditioned plant bed is then ready to receive the runner plants originating from plants in that strip of the row not disturbed. The plants remaining in this undisturbed strip should be spaced with a hoe 12 to 18 inches apart.

Mulching. Some sort of mulch is recommended, primarily to provide for clean berries. Prevention of spring frost injury, weed control, and moisture conservation, are additional benefits derived from mulching. Dirt and grit will inevitably cling to berries unless there is a protective layer of material between them and the soil. Clean pine needles or clean straw of some kind make excellent mulches. In order to produce fruit free from dirt, the mulching material must be placed around and beneath the plants just before growth is resumed in the early part of the growing season. If a sufficient quantity of material can be obtained, over and above that used to provide for clean berries, then 2 or 3 inches should be placed in the middles of the rows as an aid in holding moisture in the soil and checking weed growth. Moreover, by having available the mulch in the middles, some of it can be pulled up over the plants in case a spring frost is predicted. A sprinkling of material to cover plants that are in full bloom or have just set their fruit, is recognized as a good protective measure against frost damage. Young berries when hit by a frost are likely to be small, or badly misshapen or killed outright depending on how severe the frost is.

PEST CONTROL

The control of insects and diseases is one of the most important factors in successful fruit production. If other orchard operations such as pruning, cultivation, and fertilization are efficiently done and spraying is left undone, few if any good fruits will be produced. The most efficient means of controlling insects and diseases is by spraying, and to be effective it is very important that it be thorough, and that the correct materials be applied at the proper time. If the pest attacking the fruit plants is to be successfully combatted it is necessary that the grower have some knowledge of its nature and how it affects the plant.

The recommended spray mixtures should be followed closely since the chemicals used in preparing them may injure the plant if not properly used. In some instances injury from the spray materials may result. Such factors as vigor of plant variety, climatic conditions, time, method, and amount of materials applied will determine to some extent the damage caused from spraying.

Spray materials may be classified according to the season of application and to the purpose of application.

1. According to season:
    (a) Dormant—those applied during the winter and early spring while the plants are dormant.

(b) Summer—those applied while the plants are in leaf.

2. According to purpose:

1. Insecticides

(a) Stomach poisons—for the control of insects with chewing mouth parts, such as plum curculio or potato beetles.

(b) Contact sprays—for the control of insects with sucking mouth parts, such as San Jose scale or plant lice.

(c) Repellants—for protecting the plants against insects of both types. They do not actually kill the insects.

(d) Fumigants—for controlling all types of insects by fumigation.

2. Fungicides—materials used for the protection against fungous diseases such as brown rot of peaches, black rot of grapes, and bitter rot of apples.

3. Combination sprays—combined preparations for controlling fungi and insects with chewing or sucking mouth parts.

Spray Schedules

The dormant spray for apples, peaches, plums, and pears for the control of scale consists of 1 gallon of 66 percent oil emulsion (Government formula) mixed with 20 gallons of water. If peach leaf curl was prevalent on the peach trees the previous year, they should be sprayed with 1 gallon of oil emulsion mixed with 15 gallons of 3-3-50 Bordeaux mixture, instead of the oil emulsion alone. Bordeaux mixture is composed of copper sulphate (bluestone), hydrated lime, and water. Powdered copper sulphate (instant Bordeaux) should be used since it is easily dissolved in water. To make a 3-3-50 Bordeaux mixture, fill a 50-gallon spray tank about one-fourth full of water and while stirring add slowly 3 pounds of powdered copper sulphate and continue filling the tank. When the tank is about two-thirds full sift in 3 pounds of hydrated lime, continue stirring the solution, add water to make 50 gallons of spray material, and use immediately. Follow a similar procedure in preparing Bordeaux mixture according to other formulas recommended.

PEACHES AND PLUMS

Spring and Summer Sprays

First cover—The first cover spray should be applied when three-fourths of the petals (showy part of the flower) have fallen from the blossoms. It consists of 1 pound of arsenate of lead, 4 pounds of hydrated lime, and 4 pounds of commercial zinc sulphate mixed with 50 gallons of water. It has been shown that zinc sulphate will greatly reduce arsenical injury and its use is therefore recommended.

Second cover. The second cover spray should be applied 10 days after the first, using the same materials. Both these sprays are very important and should be applied as indicated since they are for the control of the plum curculio (the worm so often found in the fruit).

Third cover. Two weeks after the second spray an application of sulphur should be made for the control of brown rot. Wettable sulphur which is sold under several brand names is recommended since it readily mixes with water and is easy to apply. The dilution as recommended by the manufacturer should be followed closely. The usual recommendation is 3 pounds of wettable sulphur with 50 gallons of water.

Fourth cover. A second application of wettable sulphur should be made three to four weeks after the third cover spray or about four weeks before the fruit ripens, adding to this material 1 pound of arsenate of lead, 4 pounds of hydrated lime, and 4 pounds of zinc sulphate with each 50 gallons of spray for the control of the plum curculio, and to some extent, the oriental fruit moth.

Fifth cover. On late ripening varieties of peaches such as Elberta a fifth spray consisting only of sulphur should be applied 15 days before the fruit ripens to guard against brown rot. In such instances the fourth cover spray should be applied three or four weeks after the third spray.

APPLES AND PEARS

Spring and Summer Sprays

First cover. When one-third the blossoms have opened, spray with a 1-3-50 Bordeaux mixture to reduce fire blight.

Second cover. When three-fourths the petals have fallen, apply a 3-4-50 Bordeaux mixture plus 1 pound of arsenate of lead with each 50 gallons of spray.

Third cover. Two weeks after the second cover, an application of 4-4-50 Bordeaux plus 1 pound of arsenate of lead should be applied. If plant lice are attacking the young apple twigs add to the above spray one-half pint of nicotine sulphate (Black Leaf 40).

CONDENSED SPRAY SCHEDULES

PEACHES AND PLUMS

Insects and diseases	Materials	Dilutions		Time of application
		For 1 gallon of water	For 50 gallons of water	
Scale insects and Leaf curl	Oil emulsion	½ pint	3-1/3 gallons	**Dormant season** If no curl is present use oil only, 1/3 pt. in 1 gal. water; 2½ gals. in 50 gals. water.
	Copper sulphate (Bluestone)	6 teaspoonfuls	3 pounds	
	Hydrated lime	12 teaspoonfuls	3 pounds	
Plum curculio	Arsenate of lead	3 to 5 teaspoonfuls	1 pound	**First cover** When ¾ the petals have fallen
	Hydrated lime	12 to 20 teaspoonfuls	4 pounds	
	Zinc sulphate	12 to 20 teaspoonfuls	4 pounds	
Plum curculio	Arsenate of lead	3 to 5 teaspoonfuls	1 pound	**Second cover** 10 days after first cover
	Hydrated lime	12 to 20 teaspoonfuls	4 pounds	
	Zinc sulphate	12 to 20 teaspoonfuls	4 pounds	
Brown rot	Wettable sulphur	6 to 10 teaspoonfuls	2 to 4 pounds	**Third cover** Two weeks after second cover
Brown rot	Wettable sulphur	6 to 10 teaspoonfuls	2 to 4 pounds	**Fourth cover** Three to four weeks after third cover or about four weeks before fruit ripens
Plum curculio	Arsenate of lead	3 to 5 teaspoonfuls	1 pound	
Oriental fruit moth	Hydrated lime	12 to 20 teaspoonfuls	4 pounds	
	Zinc sulphate	12 to 20 teaspoonfuls	4 pounds	
Brown rot	Wettable sulphur	6 to 10 teaspoonfuls	2 to 4 pounds	**Fifth cover** 15 days before fruit ripens — for late ripening varieties

Note: If plant lice appear on the plums, nicotine sulphate can be added to any of the above sprays at the rate of 1 to 2 teaspoonfuls per gallon of spray or ½ pint per 50 gallons of spray.

STRAWBERRIES

Insects and diseases	Materials	Dilutions		Time of application
		For 1 gallon of water	For 50 gallons of water	
Leafspot	Copper sulphate	6 teaspoonfuls	3 pounds	Just before growth starts
Leafscorch	Hydrated lime	16 teaspoonfuls	4 pounds	

Note: The same spray should be repeated at 10-day to 2-week intervals until a total of four to five applications have been made.

CONDENSED SPRAY SCHEDULES

GRAPES

Scale insects	Oil emulsion	½ pint	3-1/3 gallons	**Dormant season**
Black rot	Copper sulphate	6 teaspoonfuls	3 pounds	If no scale is
Anthracnose	(Bluestone)			present omit the
	Hydrated lime	12 teaspoonfuls	3 pounds	oil
Berry moth	Arsenate of lead	3 to 5 teaspoonfuls	1 pound	**First cover**
Black rot	Copper sulphate	6 teaspoonfuls	3 pounds	Just before blos-
Anthracnose	Hydrated lime	12 teaspoonfuls	3 pounds	soms appear
Berry moth	Arsenate of lead	3 to 5 teaspoonfuls	1 pound	**Second cover**
Black rot	Copper sulphate	6 teaspoonfuls	3 pounds	Just after blos-
Anthracnose	Hydrated lime	12 teaspoonfuls	3 pounds	soms have fallen
Berry moth	Arsenate of lead	3 to 5 teaspoonfuls	1 pound	**Third cover**
Black rot	Copper sulphate	6 teaspoonfuls	3 pounds	Two weeks after
Anthracnose	Hydrated lime	12 teaspoonfuls	3 pounds	second cover
Leafhoppers	Nicotine sulphate	1 to 2 teaspoonfuls	½ pint	
Berry moth	Arsenate of lead	3 to 5 teaspoonfuls	1 pound	**Fourth cover**
Black rot	Copper sulphate	6 teaspoonfuls	3 pounds	Two to three
Anthracnose	Hydrated lime	12 teaspoonfuls	3 pounds	weeks after third
Leafhoppers	Nicotine sulphate	1 to 2 teaspoonfuls	½ pint	cover

APPLES AND PEARS

Scale insects	Oil emulsion	½ pint	3-1/3 gallons	**Dormant season**
and	Copper sulphate	6 teaspoonfuls	3 pounds	
general sanitation	Hydrated lime	12 teaspoonfuls	3 pounds	
Blossom blight	Copper sulphate	2 teaspoonfuls	1 pound	**First cover**
	Hydrated lime	12 teaspoonfuls	3 pounds	When 1/3 the
				blossoms have
				opened
Codling moth,	Arsenate of lead	3 to 5 teaspoonfuls	1 pound	**Second cover**
tent caterpillar,	Copper sulphate	6 teaspoonfuls	3 pounds	When ¾ the
scab, pear leafspot	Hydrated lime	16 teaspoonfuls	4 pounds	petals have fallen
Codling moth,	Arsenate of lead	3 to 5 teaspoonfuls	1 pound	**Third cover**
tent caterpillar,	Copper sulphate	8 teaspoonfuls	4 pounds	Two weeks after
scab, bitter rot,	Hydrated lime	16 teaspoonfuls	4 pounds	second cover
blotch, plant lice	Nicotine sulphate	1 to 2 teaspoonfuls	½ pint	
Codling moth,	Arsenate of lead	3 to 5 teaspoonfuls	1 pound	**Fourth cover**
tent caterpillar,	Copper sulphate	8 teaspoonfuls	4 pounds	Two to three
scab, bitter rot,	Hydrated lime	16 teaspoonfuls	4 pounds	weeks after third
blotch, plant lice	Nicotine sulphate	1 to 2 teaspoonfuls	½ pint	cover
Codling moth,	Arsenate of lead	3 to 5 teaspoonfuls	1 pound	**Fifth cover**
tent caterpillar,	Copper sulphate	8 teaspoonfuls	4 pounds	Three to four
scab, bitter rot,	Hydrated lime	16 teaspoonfuls	4 pounds	weeks after
blotch, plant lice	Nicotine sulphate	1 to 2 teaspoonfuls	½ pint	fourth cover

Note: When plant lice appear early in the season, nicotine sulphate should be added to the first and second cover sprays at the rate of 1 to 2 teaspoonfuls per gallon of spray or ½ pint per 50 gallons of spray.

Fourth cover. Repeat the third cover spray two to three weeks later.

Fifth cover. Repeat the third cover spray three to four weeks after the fourth cover spray.

GRAPES

Winter and Summer Sprays

Dormant spray. During the winter months while the vines are dormant, spray with a 3-3-50 Bordeaux mixture for the control of anthracnose and black rot. If scale is present add to each 15 gallons of Bordeaux mixture 1 gallon of 66 percent oil emulsion.

First cover. Just before the blossoms appear an application of 3-3-50 Bordeaux mixture should be applied to which has been added 1 pound of arsenate of lead.

Second cover. Just after the blooms have fallen repeat the first cover spray.

Third cover. Repeat the second cover spray two weeks later.

Fourth cover. Repeat the third cover spray two to three weeks later. If leafhoppers or plant lice are present add one-half pint nicotine sulphate with each 50 gallons of spray.

STRAWBERRIES

A great many insects and diseases attacking strawberries can be controlled to a large extent by proper cultural methods. Sanitary measures such as keeping the planting free of grass and weeds, providing good drainage of soil and removing all diseased and insect damaged plants are especially desirable.

Leafspot and leafscorch may be successfully controlled by spraying with a 3-4-50 Bordeaux mixture. The first application should be made just before growth starts in the spring. Continue the applications at intervals of 10 days to 2 weeks until four to six applications have been made.

DO'S IN SPRAYING

1. Weigh or measure all spray materials and follow directions.
2. Make a thorough application of the right material at the right time.
3. Secure the spray material well in advance of the time for application.
4. Be prepared. Clean all equipment immediately after use in order that it may be ready for the next spraying.

DON'TS IN SPRAYING

1. Don't use dry lime sulphur, liquid lime sulphur, or Bordeaux mixture on peaches and plums when they are in leaf.
2. Don't let the dust blow or drift on fruit trees when dusting cotton with calcium arsenate.
3. Don't use oil emulsion except during the dormant season.
4. Don't over-spray the plant. It will cause injury.
5. Don't try to spray with dirty spray equipment.
6. Don't try some new spray material unless it is recommended by an authority.

PEACH TREE BORER CONTROL

The peach borer is one of the most serious pests attacking the peach tree. Its presence is indicated by a gum or jelly-like substance at the base of the tree near the ground line. It may be controlled by the use of paradichlorobenzene (P.D.B.), ethylene dichloride emulsion, or by picking the borers out with a knife, commonly known as "worming."

Paradichlorobenzene (P.D.B.) Treatment

P.D.B. may be used safely on peach trees 4 years of age and older. On younger trees severe injury may result from its use. On 4 or 5-year-old trees use 3/4 of an ounce per tree, and on 6-year-old and older trees 1 ounce per tree. The ground immediately about the base of the tree should be cleaned of grass and weeds without disturbing the soil any more than is necessary. Apply the proper amount of P. D. B. in a continuous band about 1 or 1½ inches wide around the tree and about 1 or 1½ inches from the trunk of the tree. Several shovelfuls of soil should be placed on the ring of crystals in the form of a mound and packed with the back of the shovel. The mound of soil should be removed in about 4 to 6 weeks, depending upon the age of the tree. On 4- to 5-year-old trees remove the mound in 4 weeks; on older trees in 6 weeks.

The time of application is important if good control of the borers is expected. In North Mississippi application should be made from October 5 to 10, in Central Mississippi from October 10 to 15, and in South Mississippi from October 15 to 20.

Ethylene Dichloride Emulsion (E.D.E.)

Treatment. The use of ethylene dichloride emulsion has recently been found to be very effective as a control for peach tree borers. It has some distinct advantages over P.D.B. in that it may be used safely on young trees, is effective at low soil temperatures, may be used throughout the fall and spring, a minimum of soil preparation is necessary, and the mounds do not have to be removed. Table 2 gives the dilutions of the stock emulsion, the strength of the diluted emulsion, the dosage applied to trees of different ages and the approximate number of trees one gallon of 50 percent ethylene dichloride emulsion will treat. Various manufacturers make the emulsion in different strengths, and their recommendations should be followed.

The proper dosage as recommended by the manufacturer of the emulsion should be applied by wetting the soil immediately surrounding the tree. No preparation of the soil is necessary on loose level ground. In some cases, however, cupping the soil slightly toward the tree trunk to prevent the liquid from running off, or loosening the soil around the tree sufficiently to permit the liquid to be readily absorbed will give better results. Several shovelfuls of soil should be placed against the trunk of the tree after treatment to prevent surface loss of the fumigant. The treatment requires no later attention.

"Worming" treatment—Where a grower has only a few peach trees, the peach borer can probably be most satisfactorily controlled by worming. In this case the trees should have a mound of soil placed around the trunk about six inches high in early July. This will make it easier to locate the borers during the worming process in the fall. In November or December the mounds should be torn down and the worms removed with a sharp knife. During the worming process the cuts in the tree trunks should be made vertically so far as possible. After the tree has been wormed the soil should be placed back around the trunk of the tree for protection against freezing weather.

Rabbits may cause injury to young apple and pear trees by gnawing away the bark, especially during the winter months. A wound dressing or disinfectant, as discussed under "Pruning," should be applied. The best practice, however, is preventive in nature rather than curative and consists of wrapping the trunks of young trees in the fall with several thicknesses of newspaper or wrapping paper. By spring the paper will probably be weathered away but if not, it must be removed.

Spraying Equipment

The control of insects and diseases attacking the fruit plants can be no better than the spray equipment available. It

Table 2.—Dilution of stock emulsion, strength of diluted emulsion, dosage applied to trees of different ages, and approximate number of trees one gallon of ethylene dichloride emulsion will treat.*

Age and size of trees	Quantity of water and of stock emulsion to get proper diluted emulsion				Dosage of diluted emulsion for each tree	Approximate number trees one gallon E.D.E. will treat	
	90 percent stock emulsion		50 percent stock emulsion				
	Gallons		Gallons				
	Water	E.D.E.	Water	E.D.E.	Pints	90 percent	50 percent
Six years and older (average size and large trees)	12	5	5	5	½	54	32
Six years and older (Small size trees)	13	4	6	4	½	67	40
Four and five years	13	4	6	4	½	27	40
Three years	14	3	7	3	½	90	53
Two years	14	3	7	3	¼	180	106
One year	15½	1½	8½	1½	⅛	700	426

*Adapted from table 1, "Ethylene Dichloride Emulsion for the control of Peach Borer," by Oliver I. Snapp, U.S.D.A. Bureau of Entomology and Plant Quarantine, 424, March 1938.

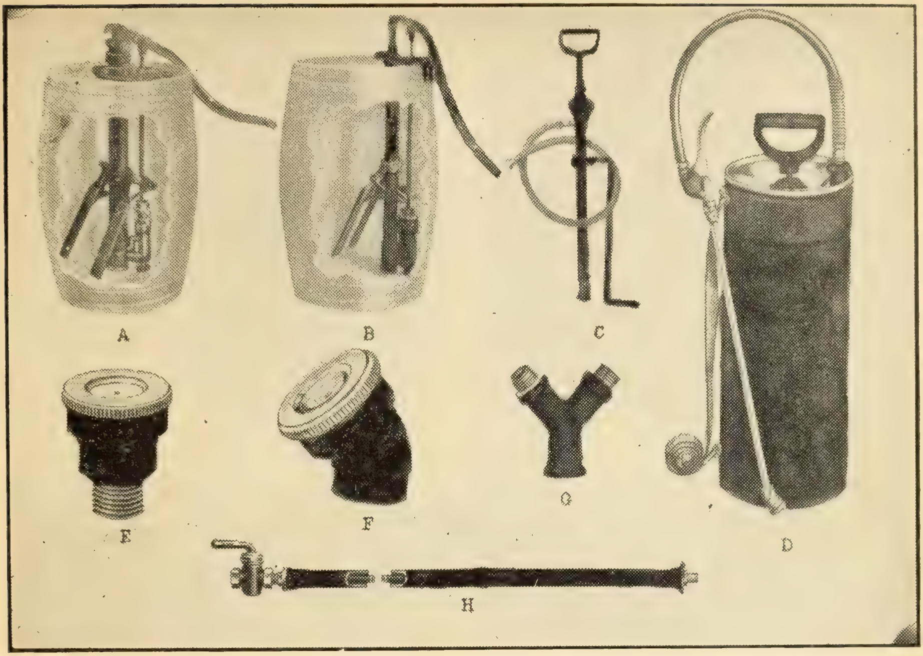

Figure 27. Illustrating various types of spray pumps and equipment. (A) heavy type barrel sprayer which fastens in the top of the barrel; (B) light type barrel sprayer which fastens on the side of the barrel; (C) bucket pump; (D) compressed air sprayer; (E) straight nozzle; (F) angle nozzle; (G) Y connection and (H) extension rod with cut off.

is false economy to purchase and attempt to use equipment which is too small for the job. The smaller spray outfits are limited as to the volume of spray material discharged and as to the pressure obtained. On very small plantings their use is justified but on plantings of one-half acre or more nothing smaller than a barrel sprayer should be used.

Spray outfits. Spray outfits may be classified under two general headings: (1) hand operated, and (2) motor driven outfits. Since only the hand-operated outfits are needed for spraying the home orchard, they are discussed here.

The compressed air sprayer. This sprayer as illustrated in figure 27-D, consists of a tank with a capacity of 3 to 4 gallons with a screw-in air pump and fitted with a strap for carrying on the shoulder when spraying. Pumping and spraying are done intermittently until the material is all sprayed out. It is easily transported and well suited to garden crops. It is too small and almost impossible to get good coverage when used for spraying fruit trees.

The bucket pump. This pump, as illustrated in figure 27-C, is a small vertically operated pump for use in any convenient receptacle for the spray material such as a bucket, tub, or earthenware jar. It is most useful for small trees and groups of plants. It may be fitted with a long spray hose and an extension rod, thus extending its use to larger trees.

The barrel sprayer. This sprayer is usually of two sizes. The smaller size (figure 27-B) fastens to the side of the barrel while the larger size (figure 27-A) is fastened in the head of the barrel. They are essentially large type bucket pumps with a 2- to 3-inch brass or bronze cylinder and the plunger worked by the upward and downward movement of a lever or handle. Agitation is provided by swinging paddles or a dasher. They may be fitted with any length hose and are more efficient when two nozzles are used on the spray rod. They are usually operated at pressures ranging from 75 pounds to 100 pounds. Their use is very satisfactory on plantings up to 2 acres, hence are very desirable for controlling insects and diseases of the home orchard.

Spraying accessories. Most spray pumps are sold with a minimum of accessories. In order to get good coverage of the fruit plants with the least effort it is desirable to have the barrel pump equipped with a 25-foot hose, cut-off, extension rod, Y connection, and two nozzles. Figure 27 shows an extension rod equipment with a cut-off, also nozzles of both the straight and angle type and a Y connection. The angle type nozzles are usually preferred, and with a Y connection two of them may be very satisfactorily used on the spray rod.

For more complete details on spraying equipment, write for Mississippi Experiment Station Circular No. 106.

FRUIT VARIETIES

The problem of selecting fruit varieties for planting in the home orchard should be given careful attention. Success or failure of the orchard is often determined through the selection of the varieties.

Varieties of fruits selected for planting should be adapted to the conditions under which they are grown, suitable for the purpose for which they were planted, and should ripen over as long a period as is practical in order to provide a continuous supply of fruits.

The varieties of fruits listed and described in tables 3, 4, 5, and 6 have been selected on a basis of their behavior at the Mississippi Experiment Station and in other sections of the State. It should be pointed out that the Mississippi Station and other southern experiment stations are doing a great deal of work in the breeding of fruits for the purpose of developing new varieties which are better adapted to southern conditions. Therefore, as the newer varieties prove their superiority to the older ones they should be selected for planting.

FIG VARIETIES

Celeste. This is the most popular fig variety grown in Mississippi. The plants are vigorous, hardy, and produce good crops of fruit; fruit is small to medium, pear shaped, ribbed; skin violet, sometimes shading to purplish brown; pulp whitish, shading to rose color at the center; very good quality. It begins to ripen the latter part of June and early July and continues for a period of three or four weeks.

Brown Turkey. Tree characters very similar to Celeste but not as hardy. Fruit medium to large, broadly pear shaped; skin coppery brown; pulp whitish, shading to pink about the seeds; quality good. Begins to ripen in early July and continues for about two months.

Magnolia. Grown for commercial purposes in the Gulf coast region of Texas but is not well adapted to Mississippi conditions. The plant is a rather weak grower and the fruit cracks badly. The fruit is large; skin greenish amber or pale green, quality good. Ripening season from mid-July until frost.

PEAR VARIETIES

Kieffer. Tree vigorous, productive, upright; fruit medium to large, oval, narrowing toward both ends; skin yellow, sometimes with red cheek, thick and tough; flesh coarse, juicy, and of poor quality unless properly ripened. Good for canning, especially preserves. Ripens in August and September.

LeConte. Very similar to Kieffer except ripens three to four weeks earlier.

Pineapple. Tree productive, vigorous, upright; fruit large, tapering toward both ends, round; skin thick, tough, creamy yellow with conspicuous dots; flesh firm, crisp, coarse and fairly juicy. Good for canning and preserves, but poor as dessert. Ripening season, August.

STRAWBERRY VARIETIES

Southland. Plants exceptionally vigorous and free of disease. Runner production is ample to make matted rows. Fruit soft and adapted only to home use. Berries large, bright crimson, and of very

Table 3. Recommended peach varieties.

Variety	Color		Stone-free or cling	Ripening date	Uses	Production
	Skin	Flesh				
Mayflower	Greenish white, red cheek	White	Cling	May 20-June 5	Fair for table and local market	Excellent
Early Rose	Creamy white	White	Cling	June 5-20	Good for table and local market	Good
Carman	Creamy white, red splashed	White	Semi-free	June 25-July 10	Excellent for table and local market	Good
Golden Jubilee	Orange yellow	Yellow	Free	July 1-15	Excellent for table, market, and canning	Good
Hiley	Creamy white, red cheek	White	Free	July 1-15	Excellent for market, table, canning	Excellent
Halehaven	Orange yellow	Yellow	Free	July 5-20	Good for table, market, and canning	Excellent
Georgia Belle	Creamy white	White	Free	July 5-20	Excellent for table, market, canning	Excellent
Early Elberta	Orange yellow	Yellow	Free	July 10-25	Excellent for table, market, canning	Excellent
Elberta	Orange yellow	Yellow	Free	July 15-30	Excellent for market, good canning	Good
Indian Blood	Dull red	Red	Cling	Aug. 1-15	Good for table and pickling	Good
Heath Cling	Creamy white	White	Cling	Aug. 15-30	Good for table and pickling	Good

Table 4. Recommended apple varieties.

Variety	Color		Ripening date	Uses	Production
	Skin	Flesh			
Yellow Transparent	Yellow	White	June 1-20	*Fair for eating, baking and salads, good pies, excellent sauce	Good
Early Harvest	Yellow	White	June 1-20	Good for eating, baking, pies and salads, excellent sauce	Good
Eckles	Red striped	White	June 5-25	Excellent for eating and salads. Poor for sauce. Fair for baking and pies	Excellent
Red Astrachan	Red	White	June 15-July 15	Good for eating, baking, pies, salads, and sauce	Good
Red June	Red	White	June 15-July 15	Good for eating, baking, pies, salads and sauce	Good
Summer Horse	Yellow	White	July 15-Aug. 15	Good for pies, baking, and sauce. Fair for eating and salads	Good
Cauley	Yellow	White	Aug. 1-30	Fair for eating and salads. Good for sauce, baking, and pies	Excellent
Delicious	Red	Creamy yellow	Aug. 10-Sept. 10	*Excellent for eating and salads. Good for sauce. Fair for baking and pies	Good
Golden Delicious	Yellow	Creamy yellow	Aug. 15-Sept. 15	*Excellent for eating and salads. Good baking, fair for pies and sauce	Good
Winesap	Bright red	Creamy yellow	Sept. 1-30	*Good for eating, baking, pies, salads, and sauce	Good
Stayman Winesap	Red	Creamy yellow	Sept. 10-Oct. 10	*Excellent for baking, pies, and sauce. Good for eating and salads	Good

*From National Apple Institute.

Table 5. Recommended plum varieties.

Variety	Color		Stone-free or cling	Ripening date	Use	Production
	Skin	Flesh				
Methley	Deep purple	Blood red	Cling	June 1-15	Excellent for table and local market	Excellent
Red June	Red	Yellow	Cling	June 20-30	Good for table use and local market	Good
Abundance	Red	Yellow	Cling	June 20-30	Fair for table use and local market	Excellent
Burbank	Dark red	Yellow	Cling	June 20-30	Good for table use and market	Excellent
Wild Goose	Bright red	Light yellow	Cling	June 20-30	Fair to good for table use, market	Good
Satsuma	Red	Red	Cling	June 20-30	Excellent for table use, local market	Good

Table 6. Recommended bunch grape varieties.

Variety	Color		Ripening date	Cluster		Use
	Skin	Juice		Size	Compactness	
Campbell Early	Black	Red	July 5-10	Medium	Medium	Good for table, market and juices
Moore Early	Black	Red	July 5-10	Medium	Medium	Good for table, market and juices
Portland**	White	Straw	July 5-15	Medium	Medium	Good for table and market
Delaware**	Red	Straw	July 15-25	Small	Compact	Excellent table and market grape
Niagara**	White	Straw	July 20-30	Large	Medium	Good table and market grape
Concord**	Black	Red	July 25-Aug. 5	Medium	Medium	Good table grape, market, juice
Champanel	Black	Red	July 25-Aug. 5	Medium	Medium	Good for juice and jellies
Extra	Black	Red	Aug. 1-10	Large	Medium	Good for table, market, and juice
Catawba**	Red	Light red	Aug. 5-15	Medium	Medium	Excellent table grape, market, juices
Muench	Black	Red	Aug. 10-20	Medium	Compact	Fair for table, market. Good juice

Muscadine grapes*

Variety	Skin	Juice	Ripening date	Size	Compactness	Use
Eden	Black	Pink	Aug. 20-Sept. 10	Medium	Loose	Good for table use and juice
Hunt	Black	Tawny	Aug 25-Sept. 15	Medium	Loose	Good for table use and juice
Scuppernong	White	Yellowish	Sept. 1-20	Small	Medium	Local markets, table and juice
Thomas	Dark purple	Tawny	Sept. 1-20	Small	Medium	For unfermented juices and preserves
James	Dark purple	Pink	Sept. 10-30	Small	Loose	Local markets, table, juices and preserves
Mish	Black	Yellowish	Sept. 10-30	Medium	Loose	Local markets, table and juice

**Should be grown on a root stock.

*Male vines are required for production of fruit in muscadines.

Blakemore. A very productive variety. Plants strong, and produce runners so freely that they must be spaced for the production of large fruit. Foliage subject to leafspot. Berries conic in shape, bright light red color, firm, and of good quality. It is considered to be one of the best preserving varieties. It is especially adapted to production in the central and northern parts of the State. Ripening date April 5-25.

Fairmore. The plants of Fairmore are large, vigorous, resistant to disease, make an ample number of runners, and produce good yields. The berries are very large, deep red, firm, and of excellent dessert quality. This variety is new but appears to be one of the very best for both home and commercial use. It is apparently best adapted to the central and northern parts of the State. Ripening date April 5-25.

Missionary. It is the commercial variety of Florida where it produces large, deep red, firm fruit of good quality. Plants vigorous, and produce runner plants freely. Foliage subject to scorch. Best adapted to the southern sections of the State and probably surpassed there by other varieties. Ripening date April 5-25.

Klondike. Plants are strong, productive, and produce runners freely, especially late in the season. Leaves subject to both scorch and spot, and frequently leafscorch reduces the yields and kills the caps of the plants. Berries large, deep red, excellent quality but extremely acid. It is considered to be one of the best freezing varieties and has been the standard commercial variety for many years in Alabama, Louisiana, and Mississippi. Ripening date April 10-30.

good quality. It is an excellent home garden variety and gives high yields. Ripening date April 1-20.

Klonmore. Klonmore is a recent introduction of the Louisiana Experiment Station and originated as a cross between Klondike and Blakemore. The plants are resistant to leaf diseases, ripen fruit earlier than Klondike and less acid. The berry is of good dessert quality, firm, and light red in color. It appears best adapted to the southern part of the State and may replace the Klondike in this section as a commercial berry. Ripening date April 1-20.

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Commercial Agricultural Production
and
Marketing Methods and Facilities
in
Mississippi

By D. GRAY MILEY

MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
STATE COLLEGE, MISSISSIPPI
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Commercial Agricultural Production
and
Marketing Methods and Facilities
In Mississippi

By D. GRAY MILEY
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This study was undertaken for the purpose of assembling information that will provide a description of the marketing systems and facilities available for handling the farm commodities produced in Mississippi. Inasmuch as there had not been an organized marketing research program conducted by the Mississippi Experiment Station, it was intended that this study provide the basic background information upon which to build a constructive research program. Therefore, throughout this report the purpose will be to explore the existing marketing practices and attempt to determine the adequacy of present marketing systems. No attempt was made to collect detailed information about any marketing situation; the purpose, rather, was to describe the marketing processes and assemble a list of the marketing facilities. It is expected that the problems brought to light by this study will be studied one by one in later detailed research projects to be conducted by the Agricultural Economics Department of the Mississippi Agricultural Experiment Station.

Commercial farm products often have to be moved considerable distances from the producer to the consumer. In order to be transported efficiently the produce has to be assembled in large quantities, sorted, packaged, loaded, and in the case of perishables, iced. Many products have to be processed before they reach the consumer and some that are produced only in short seasons have to be stored and made available as the trade demands them. There are many other functions such as, financing, risk-bearing, buying, and selling that have to be performed in the orderly movement of the produce from a large number of small farms to a larger number of consumers who often live considerable distances from the point of production. The performance of these marketing functions often costs as much as was spent in the production of the crop. The nature of the product usually determines the type of functions necessary to orderly market the crop. Perishable products such as peaches or fresh vegetables have to be moved quickly and usually have to be protected in transit by icing. On the other hand, cotton, wheat, or corn, can be stored and kept for a relatively long period of time before being processed or sold to the consumer. These factors all affect the processes and facilities necessary to efficiently handle any crop. It is essential, therefore, that the type of product, the quantity grown, the areas of production, and the existing marketing methods and facilities be known before an adequate appraisal of the marketing problems can be made.

VALUE OF FARM COMMODITIES

Mississippi had 291,092 farms in 1940. These farms occupied just over three-fifths (63.1 percent) of the State's entire land area. The average size of these farms was 65.8 acres. Land available for crops amounted to about one-third of the total land area and slightly over one-half of the land in farms. That is, of the total land area of 30,348,800 acres, 19,156,058 acres were in farms, of which 10,702,733 acres were available for crops. This means there were about 18,000,000 acres not being used for crops or improved pasture land.

During 1939, the 287,381 farms reporting to the Census Bureau, sold or traded $115,353,273 worth of farm commodities (table 1). By far the most important source of income was the group listed by the census as field crops including Irish and sweetpotatoes. This group of crops accounted for 81.5 percent of the total value of farm commodities sold or traded. Cotton lint and cottonseed are the two items that make up the greater part of the value of the field crops. The census does not give the value of these products sold, but rather reports the value of the cotton lint and cottonseed harvested. The two had a value of $90,116,356 for the 1939 crop year. It can be assumed that almost all the cotton lint and at least two-thirds of the cottonseed was sold. On this basis the value of the cotton crop sold amounted to about 85 million dollars in 1939 or about 75 percent of the total value of all farm commodities sold or traded.

Table 1—Value of farm products sold or traded in 1939 by 287,481 reporting Mississippi farmers, all types combined, detailed by classes of farm products sold[1]

Kind of products sold or traded	Number of farms reporting	Value		Percent of total	
Field crops[2]	264,614		$94,023,240		81.5
Livestock and livestock products	123,714		17,023,874		14.8
Dairy products	34,021	$7,133,306		6.2	
Livestock	60,923	6,588,145		5.7	
Poultry and poultry products	91,858	3,028,364		2.6	
Other livestock products	2,668	274,059			
Vegetables harvested for sale	13,294		1,668,661	.3	1.5
Forest products	10,782		1,274,194		1.1
Fruits and nuts	17,946		962,649		.8
Horticultural specialties	199		400,655		.3
Total products sold or traded	287,841		$115,353,273		100.0
Farm products used by farm households	277,096		$43,514,669		———

[1] Adopted from 16th Census of U. S. Agriculture, 3rd Series.

[2] Includes Irish and sweetpotatoes. There were $4,858,006 worth of both harvested in 1939.

The next most important group of farm enterprises from a sales value standpoint was livestock and livestock products. This group of commodities had a value of $17,023,874, sold or traded, and accounted for about 15 percent of the total value of farm commodities. Dairy products, with 34,021 farms reporting $7,133,306 worth of products sold or traded, was the most important item in this group. Very close behind was livestock, with 60,923 farms reporting $6,588,145 worth of stock sold or traded. Poultry and poultry products were sold or traded by 91,858 farms and amounted to $3,028,364.

The value of vegetables harvested for sale, not including Irish and sweetpotatoes, was $1,668,661 and accounted for 1.5 percent of the total value of farm products sold or traded. The total value of Irish and sweetpotatoes harvested was $4,858,006, but there seems to be no reliable means of estimating the proportion that was sold.

There were 10,782 farms that reported forest products sold or traded, with a total value of $1,274,194. There is reason to believe that this figure is far too low. The State Department of Agriculture estimates that the farm income from forestry in 1942 was $20,000,000.

All fruits and nuts sold or traded had a value of $962,649 and accounted for .8 percent of the total value of farm products.

All the above figures are for 1939 as reported by the United States Census. They give a fairly accurate indication of the relative importance from a sales value standpoint of the farm commodities produced in Mississippi.

COTTON

PRODUCTION

As far back as available statistics go, cotton has been the major farm enterprise for a large majority of farms in Mississippi. There were 2,102,000 acres planted to cotton in 1879, and as far back as 1839 there were 504,965 bales produced in the State (table 2). The largest number of acres was planted in 1930, when 4,142,000 acres were harvested, but the highest production was in 1937 when 2,561,778 bales were harvested. For the 33-year period, 1909 through 1941, Mississippi has averaged producing 1,294,402 bales of cotton per year. This cotton has been produced on an average of 3,095,152 acres, or a 33-year average yield of 209 pounds per acre. Based on a simple average of the season average yearly prices received by growers of 15.25 cents per pound for the same 33 years, the cotton crop has returned to Mississippi farmers an average of $98,698,152 per year.

The average yield per acre for both Mississippi and the entire Cotton Belt has had a tendency to increase during the past 7 years. The average of 396.0 pounds for Mississippi for 1942 is the highest per acre yield of any year on record. The average yields for Mississippi have been higher than those for the Cotton Belt during 27 of the past 35 years.

Cotton is grown generally throughout the State, but the greatest concentration is in the Delta (figure 1). Other points of concentration are the Black Paririe and parts of the Brown Loam and Longleaf Pine Areas. However, except for a group of counties in the southeastern part of the State, cotton is a major farming enterprise in almost every area.

Table 2—Cotton acreage harvested, total production, yield per acre: Mississippi and United States, and seasons average price received by farmers in the United States, Mississippi, 1839-1942[1]

Year	Acres	Total production running bales	Yield per acre (pounds)		Average price per pound (U.S.)
			Miss.	U. S.	
1839	-------	504,965	-------	-------	-------
1849	-------	484,292	-------	-------	-------
1859	-------	1,202,507	-------	-------	-------
1869	-------	564,938	-------	-------	-------
1879	2,102,000	963,111	229.1	-------	-------
1884	2,389,000	883,200	184.8	-------	-------
1889	2,891,000	1,154,725	199.7	-------	-------
1894	2,841,000	1,231,227	220.2	-------	-------
1899	2,902,000	1,239,373	213.5	185.0	6.98
1904	3,841,000	1,774,464	231.0	213.7	8.98
1909	3,237,000	1,073,105	165.8	156.5	13.52
1910	3,322,000	1,212,104	182.4	176.2	13.96
1911	3,389,000	1,169,066	172.5	215.0	9.65
1912	2,863,000	1,004,396	175.4	201.4	11.50
1913	2,961,000	1,251,841	211.4	192.3	12.47
1914	2,936,000	1,217,883	207.4	216.4	7.35
1915	2,580,000	925,509	179.4	178.5	11.22
1916	3,106,000	800,190	128.8	165.6	17.36
1917	2,476,000	886,269	179.0	167.4	27.09
1918	2,964,000	1,193,122	201.3	164.1	28.88
1919	2,854,000	950,907	166.6	165.9	35.34
1920	2,891,000	900,371	155.7	186.7	15.89
1921	2,590,000	816,961	157.8	132.5	17.00
1922	2,902,000	985,787	169.8	148.8	22.88
1923	2,971,000	622,617	104.8	136.4	28.69
1924	2,999,000	1,116,350	186.1	165.0	22.91
1925	3,618,000	1,985,524	274.4	173.5	19.61
1926	3,732,000	1,857,525	248.9	192.9	12.47
1927	3,323,000	1,346,489	202.6	161.7	20.19
1928	3,875,000	1,462,021	188.6	163.3	17.99
1929	4,037,000	1,875.979	232.3	164.2	16.79
1930	4,142,000	1,458,488	176.1	157.1	9.46
1931	3,994,000	1,719,454	215.3	211.5	5.66
1932	3,788,000	1,161,188	153.4	173.5	6.52
1933	2,830,000	1,132,152	200.0	212.7	10.17
1934	2,530,000	1,121,332	221.6	171.6	12.36
1935	2,740,000	1,226,295	223.8	185.1	11.09
1936	2,998,000	1,862,515	310.6	199.4	12.33
1937	3,421,000	2,561,778	374.4	269.9	8.41
1938	2,533,000	1,665,956	326.9	235.8	8.60
1939	2,540,000	1,536,263	302.4	237.9	9.09
1940	2,500,000	1,238,286	247.7	252.5	9.89
1941	2,498,000	1,387,558	277.7	231.9	16.80
1942	2,482,000	1,975,000	396.0	-------	-------

[1] Adapted from: **Cotton Production and Distribution**, **Season of 1940-41**, Bulletin No. 178, Bureau of the Census, p. 20, and **Agricultural Statistics, 1942, U. S. D. A., p. 100.**

The acreage and yield per acre for each type-of-farming area for the last four census years are shown in table 3. For the State there was a decided reduction in acreage for the 1939 crop year as compared to the previous census periods. This reduction, needless to say, was due

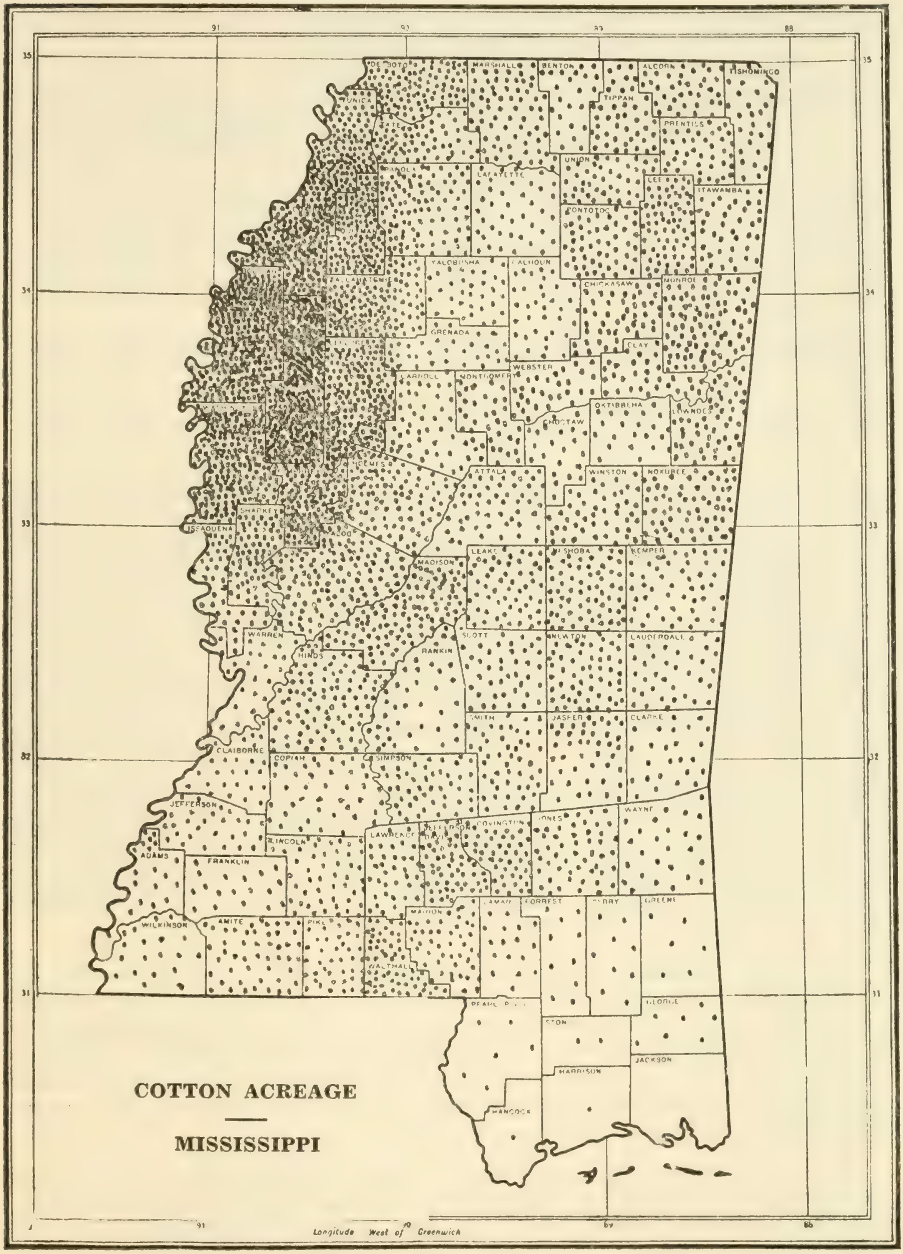

Figure 1. Distribution of cotton acreage in Mississippi, 1939.
1 dot = 500 acres
Source: Census of Agriculture, Bureau of the Census, 1940.

Table 3—Cotton acreage and yield per acre by type-of-farming areas: Mississippi, census years 1909-1939

Area	Acreage				Yield per acre (pounds)				
	1939	1929	1919	1909	1939	1929	1919	1909	Average
Delta	931,311	1,534,389	1,115,720	804,565	451	285	205	218	287.5
Brown Loam	572,582	901,983	794,227	1,078,079	274	203	142	149	183.4
Clay Hills	382,173	630,333	399,448	633,613	188	212	136	149	173.2
Oktibbeha	10,615	24,475	17,250	34,305	103	161	108	127	130.1
Black Prairie	170,742	332,719	235,474	377,370	141	203	133	127	153.1
Copiah	20,354	28,101	29,804	57,480	204	168	103	172	160.1
Upper Coastal Plain	77,406	134,813	82,720	129,167	158	183	143	143	155.2
Longleaf Pine	263,074	389,227	254,473	271,364	271	199	125	191	197.1
Lower Coastal Plain	20,235	32,329	18,580	13,690	155	155	132	202	157.4
Gulf Coastal	793	1,165	691	578	313	234	184	184	184.5

largely to government regulations. However, there were noticeable shifts taking place in the various areas before the government programs were started. For example, the acreage in cotton in the Delta steadily increased from 1909 through 1929. On the other hand, cotton acreages in the Brown Loam, Oktibbeha, Black Prairie, and Copiah Areas showed a rather definite tendency to decline long before the period of government restrictions. The Clay Hills and Upper Coastal Plain Areas remained about the same, but the cotton acreage showed a tendency to increase in the Longleaf Pine and Lower Coastal Plain Areas. These were natural and, no doubt, desirable adjustments that were coming about of their own accord. One objection to a program of restricted acreages is that it tends to maintain existing relationships. That is, the producers in all areas are allowed to plant a certain percentage of the acreage they planted at some period in the past. The trends in production in the various areas are usually ignored. The result of such a program is to hold in abeyance long-time adjustments that would take place if economic forces were allowed to take their natural course.

For the 3 census years, 1919 through 1939, the Delta had 38 percent of the cotton acreage planted in the State. From this acreage 48 to 55 percent of the State's cotton was produced. This serves to emphasize the fact that the per acre yields are much higher in the Delta than elsewhere in the State (table 3). For the 4 census years the average yield in the Delta was 287.5 pounds per acre, while for all the other areas combined it was 176.2 pounds per acre.

During the past 12 years there has been marked improvement in the staple of cotton produced in Mississippi. For the 3-year period, 1928-1930, an average of 43.4 percent of the cotton produced was below 1 inch in staple length (table 4). The proportion of cotton in the shorter staple lengths has constantly decreased. During the 2-year period, 1940-1941, there was an average of only 6.7 percent of the cotton in the staple lengths below 1 inch. Of the cotton falling in this group only 1 percent was below 15/16 inch in staple length.

Table 4—Staple length of upland cotton ginned in Mississippi by periods, 1928-1941

Staple lengths	1928-1930 percent	1931-1933 percent	1934-1936 percent	1937-1939 percent	1940-1941 percent
13/16 inch and shorter	11.8	2.6	4.4	.8	.1
7/8-29/32 inch	19.0	13.5	8.4	3.3	.9
15/16-31/32 inch	12.6	13.9	14.2	13.4	5.7
1- 1 1/32 inch	11.3	14.0	17.6	30.7	30.3
1 1/16-1 3/32 inch	20.0	18.5	21.0	30.8	35.5
1 1/8-1 5/32 inch	19.2	28.4	26.9	15.2	19.2
1 3/16-1 7/32 inch	5.4	8.4	6.6	4.3	5.7
1 1/4 inch and longer	.7	.7	.9	1.5	2.6
Total percentage	100.0	100.0	100.0	100.0	100.0

On the other hand, the proportion of the cottons with staple lengths ranging from 1 inch to 1-3/32 inch has been constantly increasing. The percentage of cotton in these medium length groups has increased from 31.3 percent for the 3-year period 1928-1930, to 65.8 percent for the 2-year period 1940-1941.

It is interesting to note that there has been a decrease in recent years in the proportion of the cotton produced that falls in the staple lenghs above 1-1/8 inch. There was a considerable increase in the long staple cottons from the 1928-1930 period to the 1931-1933 period. However, since 1933 there has been a tendency for the proportion of long staple cotton to decrease. There was a slight increase in the proportion of the longer staple cottons produced in 1941-1942 than was produced in the previous period.

In summary it may be said that the real short staples of cotton have almost completely disappeared from farms in Mississippi. The medium length cottons have constantly increased during the last 12 years, while the long staple cottons have shown a slight tendency to decrease since 1933.

The grade of cotton ginned in Mississippi, by periods since 1928, is shown in table 5. All colors have been combined and only the grade designations are shown. During the past 14 years almost no cotton has been produced that graded as high as Middling Fair and Strict Good Middling. During the period 1928-1930, 14.2 percent of the cotton produced in Mississippi was Good Middling, but by 1939-1941 the proportion in this grade had declined to 1.6 percent. The proportion that graded Strict Middling has likewise declined from 40.3 percent during the period 1928-1930 to 17.2 percent during 1939-1941.

On the other hand, the proportion of the cotton that graded Strict Low Middling has increased constantly during the past 14 years. Only 9.8 percent fell in this grade in 1928-30 but in 1939-41, 31.5 percent of the cotton produced was Strict Low Middling. Also there has been some increase in the proportion of cotton that graded Middling. The most striking shift, however, has been from Good and Strict Middling to the lower grades of cotton.

Table 5—The grade of cotton ginned in Mississippi, by periods, 1928-1941

Grade	1928-1930 percent	1931-1932 percent	1933-1935 percent	1936-1938 percent	1939-1941 percent
Middling Fair	......	......	......	......	......
Strict Good Middling	.3	......	......	......	......
Good Middling	14.2	4.9	10.2	5.5	1.6
Strict Middling	40.3	42.6	49.8	29.4	17.2
Middling	29.9	35.5	30.2	31.3	41.2
Strict Low Middling	9.8	11.3	8.8	22.9	31.5
Low Middling	3.5	2.7	1.0	7.5	7.2
Strict Good Ordinary	1.4	2.0	......	2.2	1.0
Good Ordinary	.6	1.2	......	1.0	.3
Total	100.0	100.0	100.0	100.0	100.0

MARKETING

Cotton Lint

Almost all the cotton produced in Mississippi has to be sold abroad or to mills in other states. Since the beginning of the war, the only choice has been to sell to mills in this country or for shipment through Lend-Lease. In some of the southeastern states of the Cotton Belt much of the crop goes direct from the local markets to the cotton mills. Where this is possible, the marketing process is fairly simple. In Mississippi, however, only about 3.0 percent of the crop produced in the State is consumed in local mills. The remaining 97 percent has to move from the farms through the cotton marketing process to mills in other areas of this country and abroad.

In its journey from producer to manufacturer, cotton usually passes through several agencies that perform the marketing functions. Cotton has to be ginned, stored, compressed, sampled and graded, assembled, transported, insured, and sorted into even-running lots. In addition, it has to be sold; and where there is selling, there has to be risk-bearing and financing. To perform these functions there has come into existence an elaborate and complex marketing organization. This organization is old and has been developing over a long period of years. It has become filled with customs, traditions, and habits of procedure that would be difficult to change even though something better be suggested. Many of the men performing these functions have been in the business all their lives and have learned in the school of "hard knocks." For the most part the functions these men perform are essential in the orderly and efficient marketing of the cotton crop.

The preparation of cotton for market begins with the local gin. In Mississippi the usual procedure is for the producer to deliver his cotton to the gin of his choice. He pays a set fee for ginning, bagging, and ties (usually about $5.50 per bale), and sells the seed to the gin operator. Only occasionally do the gin operators buy the cotton. The ginner performs the service of ginning the cotton and buying the seed. The gin operators had an average investment of about $15,000 in permanent equipment exclusive of land in 1935.[1] This would indicate a total investment of about $21,000,000 in ginning equipment in the State. This equipment is used for about three months during the year and remains idle for the other 9 months. The income for the ginning period has to be sufficient to cover the interest on the investment and the depreciation on the equipment and buildings for the entire year. At 4 percent the interest alone amounts to about $844,000 per year on the ginning equipment and buildings not including the land. The cost of gin operation and maintenance is ultimately paid by the producer, and any increase in the efficiency of the gin operations will result in some benefit to him as well as to the gin operator.

The actual paying of the gin fee is not usually a cash transaction. The gin operator simply deducts the fee from the amount due the producer for his seed. This practice probably results in the farmer paying less attention to the scale of fees than he would if he had to pay out the cash from his pocket.

Table 6—Ginning facilities in Mississippi,[1] by selected years, 1906-1941

Year	Number of active gins	Average saws per gin	Number of gins 4/80 equivalent[2]
1906	3,780	121	1,430
1909	3,283	135	1,387
1914	2,359	160	1,176
1919	1,695	185	982
1935	1,292	249	1,094
1940	1,280	264	1,142
1941	1,269	----	- ---

[1] **Cotton Production and Distribution, Season of 1919-20,** Bureau of Census, Bulletin 145, pp. 26-43; **Cotton Production in the United States, Crop of 1941,** Bureau of Census, p. 16; **Cotton Ginning Machinery and Equipment for Mississippi, 1935 and 1940.**

[2] Total number of saws divided by 320, the number of saws in a 4/80 gin (a gin with 4 stands and 80 saws per stand).

Historically there has been a reduction in the number of gins and an increase in the size of gins in Mississippi (table 6). In 1906 there were 3,780 actve gins in the State, but by 1941 the number had declined to 1,269. This is a reduction of about 66 percent in the number of active gins. The average number of saws per gin was 121 in 1906, but by 1940 the number had increased to 264 or an increase of 118 percent. These figures indicate that there has been a definite tendency for the volume of cotton handled by each gin to increase over a long period of years. For instance in 1909 the 3,283 active gins had a volume of 327 bales per gin, whereas in 1941 the average was 1,093 bales per gin. From the standpoint of increased efficiency of gin operations this is a very desirable shift.

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[1] Paulson, W. E.: "Cost and Profit of Ginning Cotton in Texas," Texas Agricultural Experiment Station, Bulletin No. 606, 1942. In this study of 1200 gins the average investment in buildings and equipment was $18.848 and in land, $1,098 per gin. The average gin in Texas had 4.2 stands in 1935, whereas the average Mississippi gin had 3.3 stands.

That there is still more room for improvement in the performance of the ginning operation is indicated by reference to table 7. The 214 active gins in the Clay Hills Area, for example, had an average of only 545 bales per gin for the 1941 crop year. On the other hand, the 459 gins in the Delta for the same year ginned 1,699 bales per gin. The average gin in the Delta had 3.6 stands or ginning units in 1940. For the same year the average for the Clay Hills was 3.2 stands per gin (table 8). Using these averages and applying them to the active gins in 1941, there were 472 bales per gin stand in the Delta and only 170 bales per gin stand in the Clay Hills. No area except the Delta had an average of as many as 300 bales per gin stand in 1941. The State average was 322 bales per gin stand. The 108 idle gins were not included in these calculations.

Table 7—Number of active and idle gins, bales of cotton produced, and number of running bales ginned per active gin and per stand in Mississippi by type-of-farming areas, crop year of 1941[1]

Area	Gins		Bales produced	Bales ginned	
	Active	Idle	1941	Per gin	Per stand
Delta	459	31	780,020	1,699	472.1
Brown Loam	284	28	270,545	953	280.2
Clay Hills	214	29	116,632	545	170.3
Oktibbeha	6	1	1,534	256	77.4
Black Prairie	104	10	76,062	731	228.6
Copiah	13	2	7,382	568	195.8
Upper Coastal Plain	42		29,501	702	212.8
Longleaf Pine	134	6	100,907	753	221.5
All other	13	1	4,975	380	123.4
Total	1,269	108	1,387,558	1,093	321.6

[1] **Cotton Production in the United States, Crop of 1941, Bureau of Census, p. 16; Cotton Ginning Machinery and Equipment for Mississippi, 1940, Bureau of the Census.**

Table 8—Total number of gin stands, average stands per gin, total number of saws and average saws per gin stand by type-of-farming areas, Mississippi, 1935 and 1940[1]

Area	Gin stands				Saws			
	Total		Average per gin		Total		Average per stand	
	1935	1940	1935	1940	1935	1940	1935	1940
Delta	1,679	1,765	3.5	3.6	130,900	138,820	77.96	78.65
Brown Loam	1,083	1,082	3.4	3.4	81,460	83,170	75.22	76.87
Clay Hills	755	785	3.1	3.2	55,790	59,170	78.89	75.38
Oktibbeha	21	26	2.6	3.3	1,530	1,970	72.86	75.77
Black Prairie	371	361	3.3	3.2	27,900	27,340	75.20	75.73
Copiah	51	44	3.4	2.9	3,720	3,290	72.94	74.77
Upper Coastal Plain	147	151	3.2	3.4	11,010	11,600	74.90	76.82
Longleaf Pine	458	483	3.2	3.4	34,650	36,770	75.66	76.13
All other	40	43	2.9	3.1	3,000	3,250	75.00	75.58
Total	4,605	4,740	3.2	3.4	349,960	365,380	76.00	77.08

[1] **Cotton Ginning Machinery and Equipment for Mississippi, 1940, Bureau** of the Census.

There was an increase of about 3 percent in the number of gin stands between 1935 and 1940 (table 8). On the other hand, there was a 4.4 percent increase in the number of gin saws for the same period. This indicates that the new gin stands installed were of the more modern 80-saw type. The average number of saws per stand was 76 in 1935, and had increased to 77 by 1940. The average gin in Mississippi in 1935 had 3.2 stands whereas the average was 3.4 in 1940.

Table 9—Kind of power employed in the operation of gins in Mississippi, by type-of-farming areas, 1935 and 1940

Area	Number of gins using each kind of power									
	Steam		Diesel		Gas		Electric		Water	
	1935	1940	1935	1940	1935	1940	1935	1940	1935	1940
Delta	99	44	190	251	28	32	167	160	----	----
Brown Loam	126	63	95	120	37	63	78	75	2	----
Clay Hills	102	52	55	87	57	46	40	57	5	4
Oktibbeha	3	2	----	1	3	3	1	2	----	----
Black Prairie	39	33	18	22	12	13	43	45	----	----
Copiah	11	8	2	3	----	----	5	4	----	----
Upper Coastal Plain	16	6	12	11	3	12	14	17	1	----
Longleaf Pine	55	29	48	62	12	18	25	29	7	5
All others	8	6	2	3	1	1	2	4	----	----
Total	459	243	422	560	153	188	375	393	15	9

Source: **Cotton Ginning Machinery and Equipment,** Bureau of the Census, 1940.

The type of power employed in the operation of gins in Mississippi is shown in table 9. The number of steam power gins declined sharply from 1935 to 1940. There was a decrease in every area in the State and for the entire State the decline was 47 percent in steam-operated gins. This decline was offset by increases in the number of gins using Diesel, gas, and electric power. The largest increase was in the use of Diesel power, there being 33 percent more gins using this type of power in 1940 than in 1935. There was an increase of 23 percent in the use of gas power, and 5 percent in the use of electric power for the same period.

In 1935 there were 35 seed cotton driers in the State, but by 1940 there were 200 driers. One hundred and twenty-five or 62.5 percent of these driers were in the Delta.

The gins in Mississippi are concentrated in the same areas as the acreage of cotton (figures 1 and 2). For the crop of 1935, 78 percent of the seed cotton produced in Mississippi was hauled less than 5 miles to a gin; 20 percent was hauled from 5 to 10 miles, and only 2 percent was hauled over 10 miles.[2] Usually the gins with the smallest volumes are located in the areas with sparse cotton production. The efficient performance of the ginning function, as well as other marketing functions, depends on the volume to be handled. For this reason, the producer who lives in an area that has a small volume of any farm product that

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[2] Wright, J. W.: "Marketing Practices in Producers' Local Cotton Markets," U. S. D. A., B. A. E., Mimeographed, 1938, p. 65.

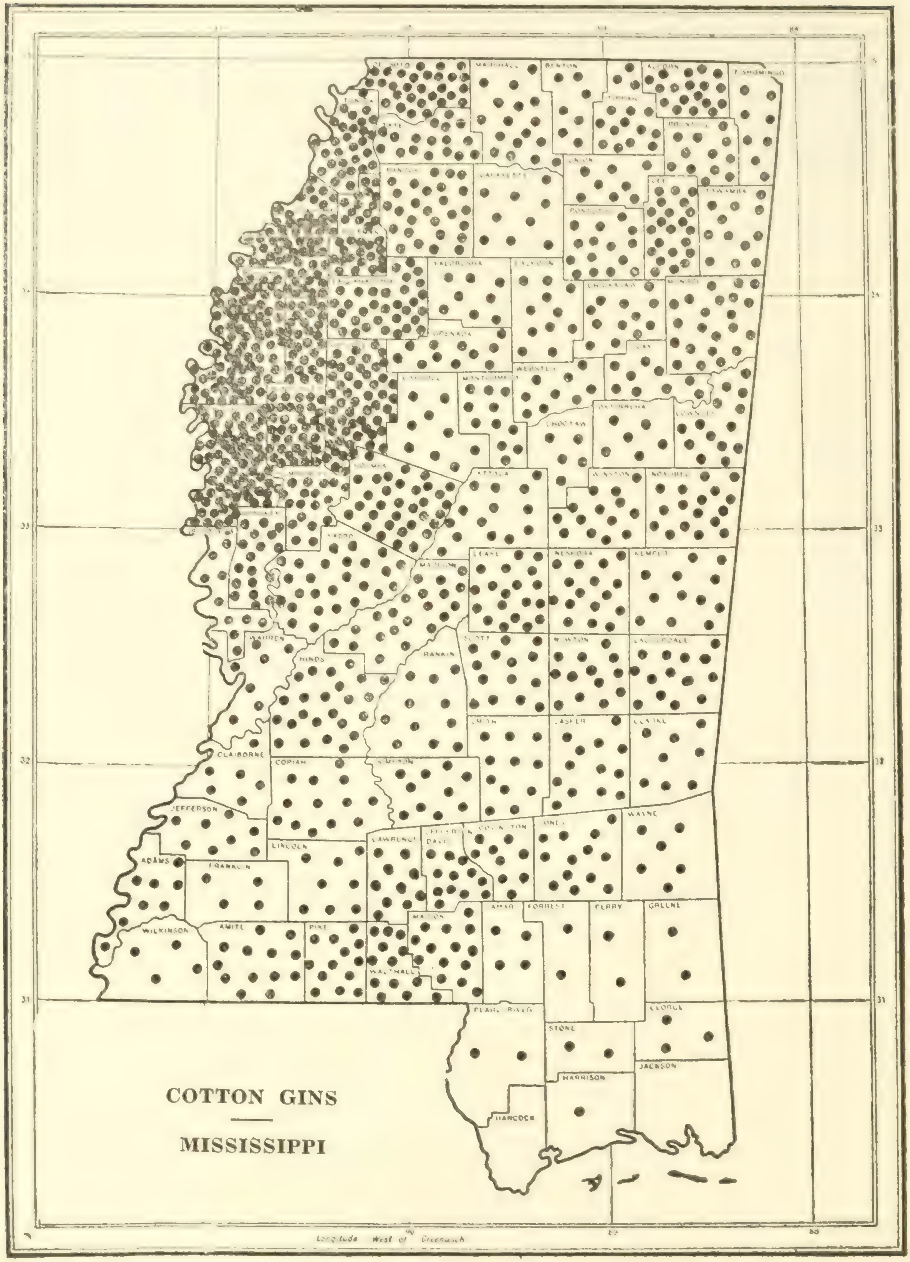

Figure 2. Distribution of active cotton gins in Mississippi, 1941.
1 dot = 1 gin

Source: Cotton Production in the United States, Crop of 1941. Bureau of the Census, p. 16.

has to be processed and shipped out to other areas, will almost always be at a disadvantage and will have to pay more for the marketing services than those producers located in areas of more concentrated production.

The importance of volume on the cost of operating gins has been forcefully demonstrated by studies conducted at the Texas Experiment Station by Dr. W. E. Paulson.[3] From these studies and others[4] it has been determined that the average gin needs at least 1,000 bales of cotton to "break even." It has already been shown (table 7) that there was not an area in Mississippi in 1941 outside the Delta in which gins had an average of as much as a thousand bales per gin. There seems to be little question but that there are still many low-volume, high-cost gins operating in Mississippi. For a cotton crop the size of that produced in 1941 (1,387,558 bales), and with ginning charges at the conservative figure of $5.50 per bale, the farmers of the State paid $7,631,569 for the ginning service, bagging, and ties. For the much larger crop of 1942 the total cost amounts to about $10,000,000. It is obvious that any increase in the efficiency of the ginning operation that results in a decrease in ginning costs will be of great value to producer and ginner alike.

For the crop year 1941, 11.5 percent of the cotton crop in Mississippi was lowered in grade because of rough or "C" preparation. This means that 159,569 bales were reduced in price because the cotton was ginned while green or wet. To some extent the farmer is at fault for delivering green and wet cotton to the gin and insisting that it be ginned. On the other hand, the preparation of wet or green cotton can be greatly improved by the installation and proper use of drying equipment. Cotton is commonly reduced at least one grade because of rough preparation. Based on the discounts for the 4-year period, 1937-1940, the average discount for Strict Low Middling, 15/16-inch cotton was 57 points. If we assume that the cotton was reduced just one grade, from Middling to Strict Low Middling, the cost to the farmers for rough preparation in 1941 was about $455,000. For a larger crop such as the one for 1942 the cost would be at least a half million dollars.

Some progress is being made in the reduction of the amount of rough preparation by the work with one-variety cotton communities and the regular check provided by the Smith-Doxey classing. The records of the cotton specialist[5] of the Mississippi Extension Service shows that the rough preparation for the one-variety cotton gins is much lower than the State average for all gins. In 1942 the one-variety gins had 3.5 percent rough preparation, while the average for the State was 11.7 percent.

Gins in Mississippi are largely privately owned and operated. In 1941 there were 110 cooperative gins in the State or about 8 percent of the total.

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[3] Paulson, W. E.: "Cost and Profit of Ginning Cotton in Texas," Texas Agricultural Experiment Station, Bulletin No. 606, 1942.

[4] New Orleans Bank for Cooperatives, "Farmers Co-ops in Mississippi."

[5] Willis, J. W.: "1942 Annual Report," Extension Agronomist, Mississippi Extension Service.

From the gin, the greater part of the cotton grown in Mississippi moves directly to the compresses and warehouses before it is sold. For the 1935-36 cotton season, only 5 percent of the cotton was sold immediately after ginning.[6] The usual procedure in the hill sections of the State where there are adequate warehousing facilities, is for the gin operator or the producer to deliver the baled cotton to the warehouse. The producer is given a warehouse receipt and a cut sample for each bale of cotton. He then offers his cotton to the local buyers who make bids based on their estimate of the value of the cotton represented by the sample. These samples are taken by licensed and bonded warehouses and are accepted by the entire cotton trade. In most cases the samples are sealed when they leave the warehouse, and the first buyer that examines them has to break the seal. Other buyers that later examine the samples have to take the producers' word that no substitutions have been made. Cotton buyers throughout the State agree that only a few farmers abuse this privilege.

In the study referred to above it was found that 48 percent of the growers sold their cotton to the first buyer interviewed, while 30 percent interviewed 2 buyers, 16 percent interviewed 3 buyers, 5 percent 4 buyers, and 1 percent interviewed 5 buyers before selling.[7] For the most part, growers in Mississippi are so situated that they can have a choice of buyers. In many small communities, however, there are only part-time buyers, and in some places only one or two of these.

For the 1935-36 season 29 percent of the cotton in Mississippi was bought by independent local buyers, 17 percent by representatives of cotton merchants, 26 percent was handled by cooperatives, 1 percent by supply merchants who used to handle large percentages, and 27 percent was handled by cotton factors.[8] A recent check in all the major cotton markets of the State revealed that there had been only slight changes in this situation. Because of the fact that the Cotton Cooperative Association is no longer in operation, the proportion handled by cooperatives is less now than then. This, of course, has resulted in a higher proportion of the crop being handled by the other groups. The only large cooperative marketing organization handling cotton in the State now is the **Staple Cotton Cooperative Association** of Greenwood.This association handles about one-third of the cotton grown in the Delta. However, the Mississippi Federated Cooperatives has handled some cotton during the past few years. A majority of the cotton handled by this organization has gone into the Government loan. For the period June 16, 1941 to June 15, 1942, the Federated Cooperatives placed 14,214 bales of cotton in the loan. In addition to these two cooperatives, the Farm Security Administration has sponsored a cooperative organization to handle the cotton grown by its clients. This is a new organization and has operated only one season.

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[6] Wright, J. W.: "Marketing Practices in Producers' Local Cotton Markets,' USDA, BAE, mimeographed, 1938.

[7] op. cit., p. 71

[8] op. cit., p. 69

When expressed as a percentage of the State total the cotton handled by factors is misleading. The important markets where factors operate are located in the Delta at Greenwood, Clarksdale, and Greenville. In these three markets from 75 to 90 percent of the cotton is sold from factors' tables. The cotton factor or broker simply acts as an agent for the producer or for anyone else who wants to sell cotton in this fashion. He places the cotton samples on tables in his place of business where they show to best advantage and can be examined by prospective buyers. If the factor gets what he thinks is a satisfactory bid, he checks with the owner of the cotton to see if he will accept the bid. If so, the sale is completed. The usual factor charge for this service is 20 points or an average of about $1.00 per bale. Outside of these three markets almost all of the cotton is bought outright by the various types of cotton buyers.

The cotton compress and warehouse plays an important part in the cotton marketing process. Where the warehousing facilities are adequate, the marketing process moves rather smoothly and trading is done on the basis of a sample which is accepted by all branches of the trade. However, where there is no bonded or licensed warehouse to do the storing and sample-taking, the marketing process takes quite a different turn. In such cases there are usually platforms or gin yards where the buyers go to see and sample the bales of cotton. If the offers are satisfactory and sales are made, the buyer takes title to the cotton and moves it to the warehouse of his choice. Where rail facilities are available, the cotton is usually "floated" to the nearest compress and warehouse. The "floating" privilege is an agreement between the railroads and the cotton trade whereby the cotton is shipped to the warehouse and the freight charge added to the bill of lading. The freight is paid when the cotton is resold. This privilege applies only to the first shipment, that is, where the cotton is moving into the warehouse for the first time.

The location of the compresses and warehouses in Mississippi in 1941 is shown in figure 3. These facilities are adequate to handle the cotton produced in any normal year. Their total capacity is around two million bales. In the areas where the volume of cotton is not large enough to support a warehouse or compress the cotton has to move longer distances, and consequently this phase of the marketing process is more expensive than for the more concentrated areas. It is possible and quite desirable, however, that efficiencies be introduced into the handling of cotton in these sparse areas so that the old system of selling off the wagon or off the gin yard or platform be improved upon. Just how this can be done will have to await further study of this phase of cotton marketing.

From the first buyers the cotton usually moves into the hands of the cotton merchants. In the case of the local independent buyer the cotton is sold direct to the large merchants. Only a few of the larger local buyers have mill connections. In the case of the local representatives of the large cotton merchants the purchases of each representative are reported regularly to the central office. These central offices usually re-

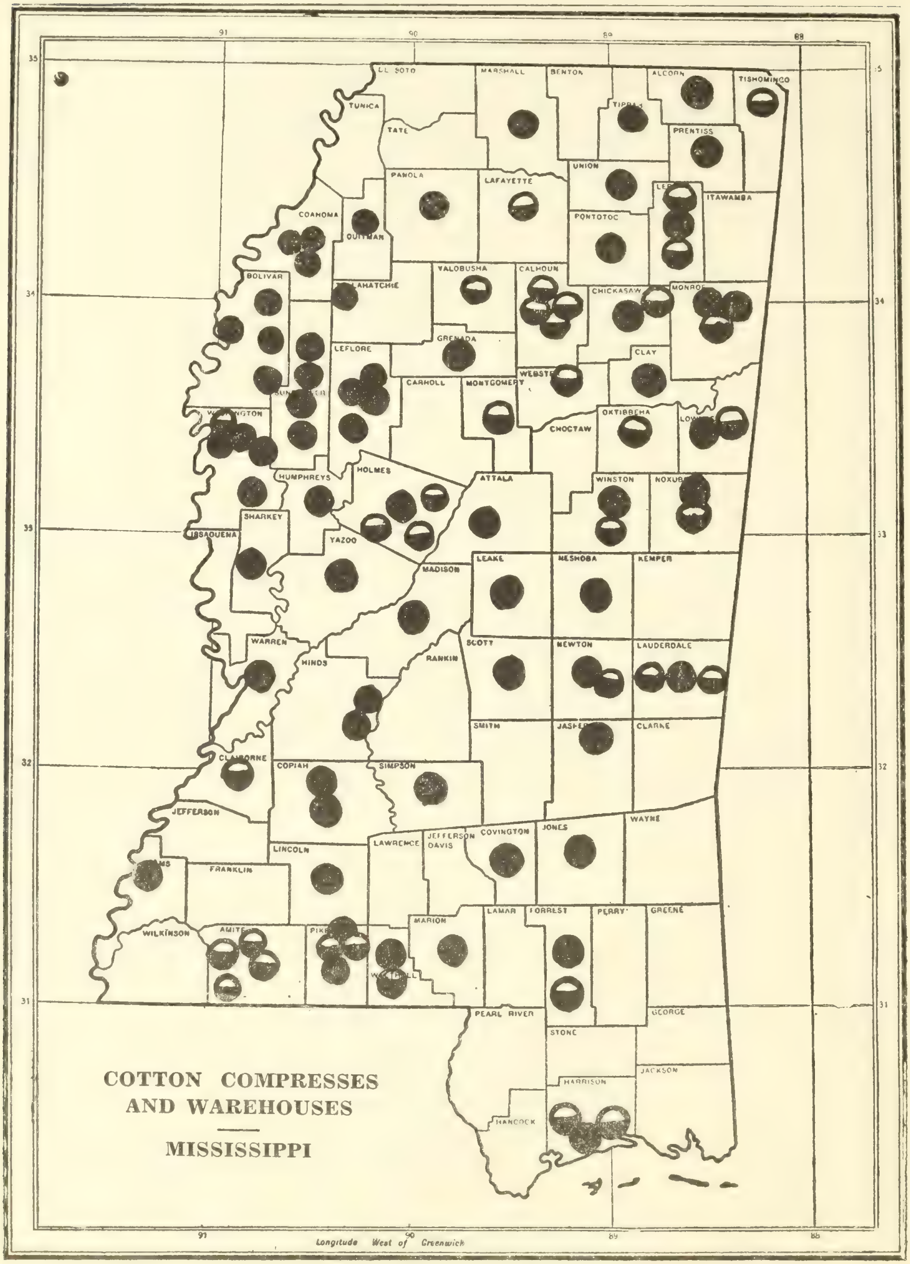

Figure 3. Location of compresses and branch warehouses of cotton compress and warehouse companies and independent warehouses.

● Compress and warehouse companies

◒ Independent warehouses

Source: Index of Manufacturers in Mississippi, Miss. Board of Development.

quest new samples from the warehouse where the cotton is stored. All these samples are then classed by skilled classers employed by each firm and the cotton placed in even-running lots. They are then offered for sale to the mill trade, the seller usually guaranteeing the cotton to be as described. If the mill buyer rejects the cotton on the ground that it is not as described and the seller does not agree, he can submit the samples to the Cotton States Arbitration Board at Atlanta, Georgia, where a decision will be rendered. If the Board determines the cotton is as described, the mill has to take it at the agreed price; if not as described, the seller has to adjust the price or sell elsewhere. The transfer of cotton from the local buyers or representatives to the cotton merchant is a book transaction. The cotton itself is usually not moved until the merchant is ready to ship it to the mill.

In summary, the steps that cotton takes from producer to the spinner are about as follows:

1. Producer to local buyer
2. Local buyer or representative to cotton merchant
3. Cotton merchant to domestic spinner through mill broker or buyer

During normal times cotton for export usually goes about as follows:

1. Producer to local buyer
2. Local buyer or representative to cotton merchant
3. Cotton merchant to foreign importer
4. Foreign importer to foreign spinner through mill broker[9]

There are many variations to the above pattern, but these seem to be the most important channels taken by cotton on its way from the producer to the spinner. It is a long and costly process. Just how costly and what progress has been made in reducing the cost appears not to have been adequately determined. Until this is done, any suggestions as to improvements that might be made will be immature.

In recent years, however, there has been an attempt to eliminate some of the marketing costs by having all the cotton classed before it leaves the farmer's hands. At present, each buyer and merchant either does his own classing or hires classers to perform this service. Thus, each large cotton merchant maintains a corps of classers.

If the performance of this function could be concentrated in one place and could be done so that the entire cotton trade would accept the classes, it would mean a very large saving in the cost of cotton marketing. To try out such a scheme the Smith-Doxey cotton classing offices were established in connection with a program of one-variety cotton community development. The idea was to get the farmers in organized groups to grow one variety of cotton and have samples of each bale sent from the gin to the nearest cotton classing office for classification. The grade and staple would be sent back to the farmer and he would then sell on the basis of the government class.

The establishment of the one-variety communities in Mississippi has made progress. There were 208 such communities approved for 1942. They had 16,505 members, who planted 250,811 acres of cotton and produced 188,831 bales. Of this amount, samples of 98,808 bales were sent to the classing offices at Jackson, Mississippi and Memphis, Tennessee.

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[9] **op. cit., p. 7**

One of the main objectives of the classing program has been defeated due to the fact that almost no one in the cotton trade in Mississippi accepts, or will buy on the basis of, the government class. In answer to questions designed to find why this was true, a large variety of opinions was obtained. In the hill sections of the State the buyers were almost unanimous in their statements that the cotton was over-classed. On the other hand, the buyers in the Delta stated that it was under-classed. Almost all local buyers said they could not sell the cotton on the basis of the government class, therefore, they could not buy on that basis. In many cases the practice of taking press box samples was questioned. The usual practice for many of the gins in the one-variety area has been to take a press box sample to send away for classing. The farmer, of course, gets his report based on this sample. The accepted practice in the trade is to cut a sample from each side of the bale. Thus, the buyer gets a cut sample which may or may not agree with the press box sample. If they should differ, the buyer naturally offers a price on the basis of the sample he sees. The farmer has been led to believe that his sample and grade are correct and that he can sell on that basis. When he finds that he cannot, confusion results.

Many buyers expressed a definite willingness to use the official grades if they become generally accepted. At present almost all the buyers insist on having a sample to see for themselves what the cotton will class. This is true for loan cotton as well as for that sent from the one-variety communities. Such being the case, the good the Smitth-Doxey classing has done has been limited to the extent of giving the farmer a better idea of what his cotton is worth. This is one of the main advantages of the classing service. It places the producers who have a class on their cotton in a much better bargaining position than those who do not have it.

The cotton trade feels that there will not be general acceptance of official government classing as the only basis for trading until the human element is more completely removed from the classing process. At present a lot of strictly human judgment is involved, and no two classers, however good, will put the same class on each bale of a large lot of cotton. The difficulties involved are apparent when the elements taken into account in arriving at a cotton class are examined. Three factors are considered: grade, staple, and character. The grade is determined by the color, amount of foreign material, and preparation. These are determined entirely by observation and where available, by comparison with an official standard. The staple length is judged by observation and is supposed to be given in intervals of thirty-seconds of an inch. Needless to say, it is practically impossible for the human eye to judge correctly to a thirty-second of an inch the length of cotton fiber in every case. The other factor, character or strength of the fiber, is also a matter of judgment and perhaps even harder to determine by a mere hand examination than are the other factors. It can be readily seen that where so much judgment is involved there will always be differences of opinion. Members of the cotton trade feel that if they are going to risk their money in buying cotton, they want to risk it on their own opinion rather than some other person's. Because of the difficulties involved, a rather long period of training and experience is required to become an expert cotton classer. The cotton merchant is risking his money on his ability to properly class and value cotton. Often he has a particular mill account that takes a specified type of cotton. He knows what this mill wants and he is always on the lookout for cotton that will fill that need.

So far, it seems that the system of government classes has not been worked out to the extent that it is generally adapted to the filling of the specified mill demands. The cotton people do not feel that the present classes will ever be generally accepted by the trade so that cotton can be sold throughout the marketing process on the basis of description. It goes without saying that if any classing system is to achieve its maximum usefulness, it must be acceptable to and used by a majority of people in the cotton trade. These observations apply only to conditions as they were found in Mississippi. Reports indicate that the classing service has been more generally accepted in many of the other cotton states.

Some recent research conducted at the Ginning Laboratories of the Cotton and Fiber Branch of the Food Distribution Administration on the spinning quality and breaking strength of the different classes and varieties of cotton shows promise of doing much to improve the present system of classing cotton. The results of some of this work were recently published in a bulletin issued by the Texas Experiment Station.[10] The tests conducted so far indicate that the variety of cotton is the most important factor determining its spinning quality. The staple and grade have not proved to be adequate measures of strength and spinnability. These recent tests have shown that variety is another important factor that supplements grade and staple as measures of quality and that the real spinning strength can be judged only when all three are taken into consideration.

A short summary of the research results obtained at the Ginning Laboratory at Stoneville, Mississippi, was given recently by Mr. Francis L. Gerdes. He said in part:

> "Cotton research conducted, sponsored, and encouraged by Federal, State, and private agencies during the past 15 years, is paying high dividends and making distinct contributions to the wartime cotton program. During this brief time, numerous practical developments of considerable value have been effected, and many practices have been modified or introduced as a result of this intensified work on the part of research workers. New concepts of cotton problems have been developed, and ideas about a number of aspects have been changed. Many of us can remember when it was generally thought in some quarters that rough ginning was caused to a great extent by fast saw speeds. Now we have data which prove beyond a shadow of a doubt that increas-

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[10] "Gearing Texas Cotton to War Needs," Texas Agricultural Experiment Station, Bulletin 624, 1942.

> ed saw speed reduces rather than increases rough ginning, and that the density of the seed roll is virtually the only mechanical factor in ginning that influences ginning preparation.
>
> In the early years of the development and advocacy of the cotton gin drying processes by the U. S. Cotton Ginning Laboratory, it was thought by some consumers of cotton that this practice was generally injurious to the spinning quality of cotton. Through research, we have been able to sufficiently refine and modify the process and its use to overcome this criticism; and now at least 3 million bales of cotton are annually conditioned by this process with consequent improvements in ginning preparation of the cotton. The drying process in the early years of its adoption was criticized further on the basis of its alleged adverse effect on storage qualities of seed ginned from seed cotton conditioned in driers. Systematic investigations revealed that the drying of green, damp, or wet cotton before ginning did not increase the rate of deterioration of the seed in storage but actually caused retardation of the formation of free fatty acid.
>
> Through ginning investigations conducted over a period of years, it has been proved that where one gin gives a higher gin turnout than another, the spinning quality of the cotton is not necessarily impaired by the higher turnout. Of course, when the seed are 'skinned', so to speak, additional mill waste and neppier yarns result. By maintaining loose seed rolls, employing high saw speeds—600 to 700 revolutions per minute—and modern design saws of full diameter and in good condition, we have found that we can obtain a more nearly perfect removal of usable fibers from the seed, and increase turnout without the inclusion of substaple fibers.
>
> In other fields of work, where cotton fiber and spinning tests have been used as a tool in determining quality relationships, many more important findings have been brought forward. In the field of cotton breeding, it has been definitely established that the variety of cotton is the most important single factor affecting spinning quality, and that staple length is not as important as once believed by many of us concerned with cotton production and marketing problems. It has also been definitely determined that place of growth is not nearly so important as generally conceded in influencing spinning quality of cotton."[11]

Another long recognized fault of the present cotton marketing system is that it has maintained the practice of "hog round" or "point" buying in the farmers' local markets. That is, buyers have paid about an average price for the cotton sold in each market and have not paid premiums for the better qualities of cotton. This has tended to discourage the farmer in his attempts to produce better quality cotton. However, it is the opinion of many competent and reliable cotton buyers that this situation is gradually being improved and that each farmer is getting about what his product is worth. A combination of factors is bringing about this desirable situation. The influence of cooperatives in handling and selling on a graded basis has helped to force buyers to quit "hog round" buying. The very close check that the central offices of the cotton merchants keep on their local and district representatives forces them to stay about in line on their classing and pricing of the cotton they buy. In almost all the markets where there is sufficient volume, there is keen competition, with the result that many of the more inefficient local buyers have been forced to give better service or go out of business. It is usually in the smaller, low volume markets where there is not enough cotton to attract the large cotton merchants that the old system of "point" buying is still maintained.

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[11] Gerdes, F. L.: "Current Cotton Testing Activities Relating to Quality Improvement," pp. 1-2.

This is not to say that there is no further room for improvement in the larger markets but simply to emphasize the fact that efficiencies in the marketing system are much more difficult of attainment in the sparser areas than the more concentrated centers of production. There is no ready made answer to the marketing problems in any area and especially is this true for low-volume area. It is very likely that short-sighted, snap-judgment efforts to solve the marketing problems coupled with the prevalent attitude among farm people and many professional workers that the way to solve the problems is to eliminate the "middleman", have done more to delay improvements in the marketing system than to bring them about. Long-time, desirable improvements usually come about as a result of a systematic and thorough study of the existing marketing situations.

Cottonseed

As mentioned previously, in most instances the cottonseed is bought by the ginner who in turn sells it to the oil mills. The cash farm income from cottonseed has greatly increased during the past 3 years (table 10).

Table 10—Cash farm income from cottonseed, proportion of total income from cotton represented by cottonseed, farm income per ton of seed, value of crude products from a ton of seed and oil content, Mississippi, 1940-42

Year	Cash income from cottonseed	Percent income from seed is of value of lint and seed	Farm value per ton of cottonseed	Value of crude products from ton of seed	Percent oil content
1940	$ 9,161,000	14.1	$16.48	$39.89	17.7
1941	26,341,000	17.8	41.48	67.82	16.6
1942	33,270,000	15.2	....	....	.....

Source: Bureau of the Census, Cotton Production and Distribution in the United States, Crop Years, 1939-40, 1940-41, and 1941-42, Bulletins 177, 178, and 179.
Bureau of Agricultural Economics, U. S. D. A. Farm Income, 1942.

The farm value per ton of cottonseed was $16.48 in 1940 and by 1941 had increased to $41.48 per ton. The value of the crude products from a ton of cottonseed has likewise increased during the past 3 years; however, the margin between the value of the cottonseed and the crude products has remained about the same.

The percentage of oil extracted from the cottonseed grown in Mississippi is fairly high. The average oil content for all the seed crushed in 1940 was 17.7 percent, and in 1941 the seed had an oil content of 16.6 percent.

For the 3-year period 1940-1942 the 41 oil mills in Mississippi crushed an average of 570,171 tons of cottonseed per year (table 11). From this quantity of cottonseed there was produced an average of 195,255,000 pounds of oil, 240,709 tons of cottonseed cake and meal, 140,829 tons of cottonseed hulls, and 165,727 bales of linters. The combined value of these products averaged about $28,000,000 each year for the 3-year period 1940-42.

Table 11—Cottonseed crushed and cottonseed products produced in oil mills in Mississippi during 1940, 1941, and 1942

Year	Cottonseed crushed	Crude cottonseed products			
		Oil	Cake and meal	Hulls	Linters
	ton	pounds	tons	tons	bales
		(000)			
1940	641,291	219,915	277,429	158,001	176,503
1941	502,290	177,452	206,655	127,130	146,201
1942	566,931	188,399	238,044	137,357	174,476
Average	570,171	195,255	240,709	140,829	165,727

Source: Bureau of the Census, Cotton Production and Distribution, Seasons 1939-40, 1940-41, and 1941-42, Bulletins 177, 178, and 179.

Normally a ton of cottonseed produces an average of about 333 pounds of cottonseed oil, 860 pounds of cake and meal, 504 pounds of cottonseed hulls, and 177 pounds of linters. These are average figures for the cottonseed crushed in Mississippi for the 3-year period, 1938-1940.

Cottonseed oil is used almost entirely as an edible oil. Only the very poor qualities are used for other purposes, mainly in soap making. The greater part of the oil is used in shortening and various salad oils and dressings. An increasing amount is being used in margarine, but the expansion of markets for this entirely wholesome table spread has been hampered by Federal and State trade barriers. In 1942, 48 percent of the margarine produced was made from cottonseed oil. Some of the restrictions are: the margarine manufacturer has to pay $600 for an annual federal license; then he pays a federal tax of ten cents a pound if the margarine is colored; one quarter of a cent if it is white. The wholesaler pays $480 for a license to sell the colored product and $200 for the white. In addition each retailer pays a $6.00 license fee. On top of the federal taxes many states add other restrictions. The state of Wisconsin, for instance, has a manufacturers tax of $1,000, a sales tax of 15 cents a pound, a wholesaler's license costs $500, a retailer pays $25, and boarding houses $5.

At one time Mississippi had a tax on margarine but it has been removed. The only law affecting the sale of margarine in the State now is one that requires the containers to be plainly marked and specifies that all eating establishments that serve margarine shall hang cards on which are printed the words "Oleomargarine Used Here" opposite the tables or other places where guests are served. Eating establishments that color and serve margarine have been subjected to the $600 tax on manufacturers. Even school lunch rooms come in this classification. That is, if a school lunch room buys and colors margarine it is classed as a manufacturer and is subject to federal tax.

Federal and State discrimination set up under the guise of revenue laws actually costs the producers and consumers of margarine more than they bring in in revenue. This cost falls heaviest on the families who are least able to pay it. Families in the lower income groups who have never been able to buy much butter furnish the greatest present and potential market for margarine.[1]

The location of the cotton oil mills in Mississippi is shown in figure 4. Nearly half of these mills are located in the Delta. Outside the Delta, with the exception of the four mills in Jackson, the oil mills are fairly well distributed over the State. In many of the outlying areas, however, the seed has to be transported considerable distances from the cotton gins to the nearest oil mill. A large proportion of the seed from the sparsely settled areas is hauled in trucks.

The grading of cottonseed is in many respects more difficult even than the grading of cotton lint. Because of the fact that there are two main and two minor products obtained from cottonseed, it is necessary to take several factors into account when arriving at a grade for cottonseed. In the early attempts to grade cottonseed, only the oil content was considered. However, it was found later that the cottonseed cake and meal was almost as valuable as the oil. In fact, during some years, the cake and meal are more valuable than the oil. More recent attempts to develop suitable grades for cottonseed have been based almost entirely on the oil content and the quantity and quality of cottonseed cake and meal.

The United States Department of Agriculture began research for the purpose of developing cottonseed grades in 1917. With the exception of one short interruption, this work has been continued until the present time. The Department of Agriculture representatives have worked very closely with the National Cottonseed Products Association and the cottonseed grades in use at the present time are the results of the joint efforts of these two organizations.

No attempt will be made here to give any detailed information about the development of cottonseed grades nor the details of the present grading system. This detailed information has been given in other publications.[2] However, in order to show the difficulties involved in properly grading cottonseed, some examples will be given to show the actual processes involved in arriving at the grade of a lot of cottonseed.

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[1] Howell, L. D., "Internal Trade Barriers for Margarine," Journal of Farm Economics, Vol. XXV, No. 4, Nov. 1943., p. 793.

[2] Meloy, G. S.: "Development of Standards for Grades of Cottonseed," Bureau of Agricultural Economics, Washington, D. C., June 1935; "Rules Governing Transactions Between Members of the National Cottonseed Products Association, 1942-43."

The factors considered in grading the seed are the oil content, the percent of ammonia in the cake and meal, the percent of free fatty acids, the moisture content, and the foreign matter. The correct determination of most of these factors requires controlled chemical analyses. After these analyses are made, the grade is determined by a combination of what is known as a quantity index and a quality index. The quantity index is arrived at by a revision of what is known as the oil-cake reciprocal method. It was found that a change of approximately one-fourth of 1 percent of the oil content when the ammonia content remains constant, results in a unit change in the quantity index. Also, when the oil content remains constant, a change of one-sixth of 1 percent in the ammonia content results in a unit change in the quantity index. These facts suggested the formula that is used for calculating the quantity index. That is, 4 times the percentage of oil, plus 6 times the percentage of ammonia, plus 5, equals the quantity index. For example, if a lot of seed had 18.5 percent of oil and 3.5 percent of ammonia, the quantity index would be arrived at as follows:

4 x 18.5 = 74.00
6 x 3.5 = 21.00
Plus 5.00
Quantity Index 100.00

It can be readily seen from this example that seed with different amounts of oil and ammonia will have different quantity indices.

The quality index is arrived at by considering the moisture content, the free fatty acids, and foreign matter. For example, superior quality cottonseed are those seed that contain not more than one-half of 1 percent foreign matter, not less than 9 percent nor more than 10 percent moisture, and not more than one-half of 1 percent free fatty acids in the oil. Seed having these characteristics are given a quality index of 102. Other and lower quality designations are made for seed having higher proportions of foreign matter, moisture content, and free fatty acids.

The grade of cottonseed is arrived at by a combination of the quantity and quality indices. An illustration of the method of calculation is as follows:

Superior Quality No. 2 Analysis: 18.6% oil, 3.94% ammonia, 9.5% moisture, 0.50% free fatty acids, 0.5% foreign matter.

4 x 18.6 = 74.40
6 x 3.94 = 23.64
Plus 5.00
Quantity Index = 103.04
Quality Index = 102.00

$$\frac{103.04 \times 102}{100} = 105.10 = 105$$

Because of the difficulties involved, it is not possible to make grade determinations on small lots of cottonseed. The rules of the National Cottonseed Products Association specify that its members shall determine the grade on all lots of seed having as much as 10 tons. For lots of smaller quantities, prices are based on the average analysis of cotton-

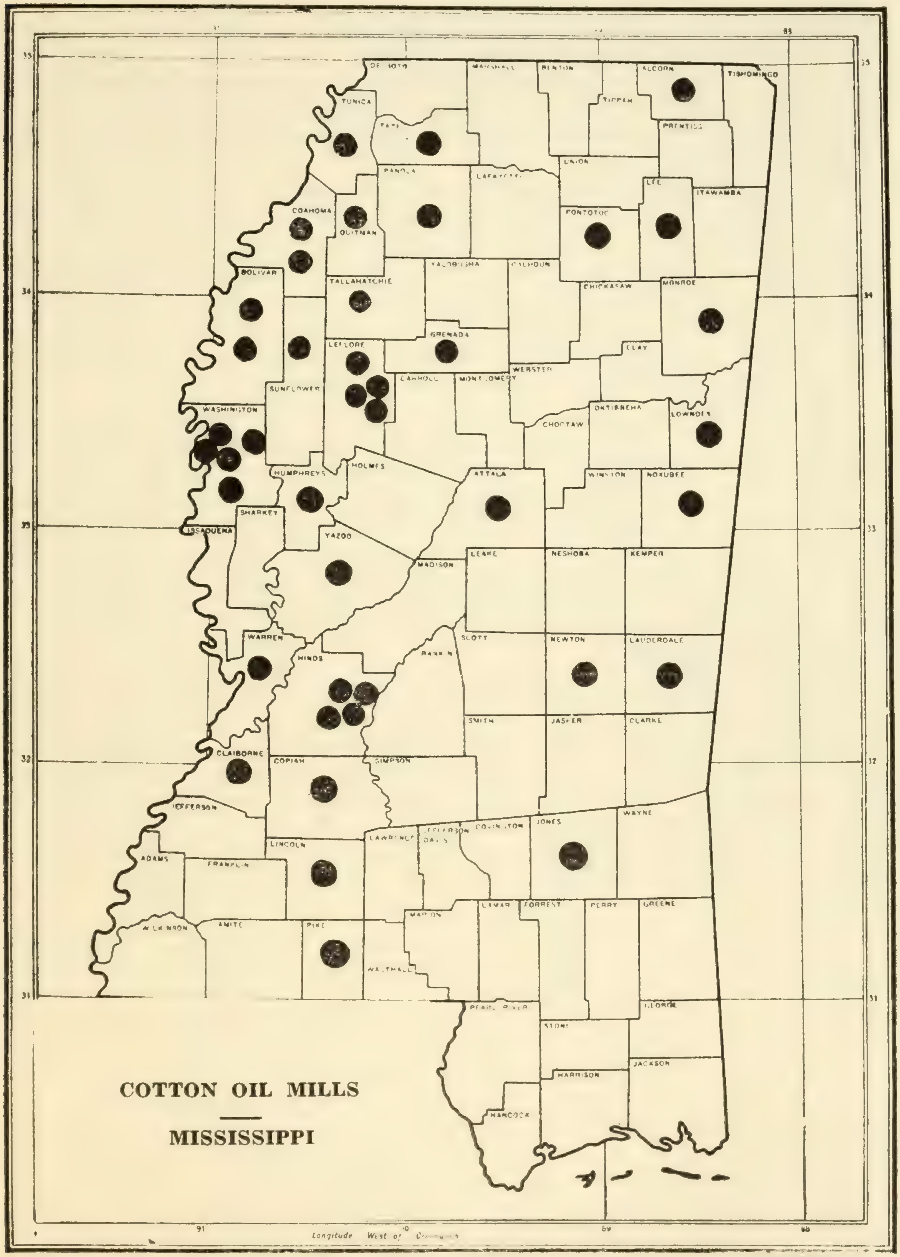

Figure 4. Distribution of cotton oil mills in Mississippi, 1942.
1 dot = 1 cotton oil mill

Source: Index of Manufacturers in Mississippi, Mississippi Board of Development.

seed coming from the same area. Because of the fact that trained chemists and technical chemical apparatus are needed in grade determination, it has not been possible to grade cottonseed at any place except the oil mills. This means that the oil mills buy large quantities of their supply of cottonseed from the cotton gins on the basis of the grade of the seed.

Any one truck load or car load of seed going to the oil mills may contain the seed from a number of different farms. An attempt is made at the oil mill to get an adequate sample of the entire load of seed. For sampling seed a "trier" has been developed for getting the proper sample. This instrument is somewhat like a large auger and is bored down through the seed to the bottom of the car or truck and then pulled out so that a sample is obtained from all sections of the seed pile. Samples are usually taken from about 10 places in each carload of seed.

Thus far, the grading technique developed for cottonseed has not been such that the producer has received much benefit from the grading process. The expense of the grading system is so great that it cannot be applied to small lots. Therefore, except in cases where a farmer controls a rather large lot of seed, the producers have not been able to sell the seed on a graded basis. Under such a system, the farmers who produce high quality seed usually do not get much, if any more, for them than the farmers who produce poor quality seed. The ginners in most communities usually pay about the same price for all cottonseed regardless of its quality.

Because of this situation, there has been little emphasis placed on the production of high quality cottonseed either by farmers or research institutions. Almost all cotton breeding research has been directed toward the improvement of cotton lint. The cottonseed has been regarded as a by-product by both producer and researcher. Consequently, the usual procedure has been for the farmer to choose the gin that would give him the best service in the preparation of his lint and take what was offered for his seed. Such a system does not offer the farmer a fully competitive market for cottonseed.

However, the great emphasis being placed on oil seeds during the war period is having a tendency to change this situation. Even though a producer does not sell in a competitive market, if he checks the regular government cottonseed price reports, he should have a fair idea of the value of his seed before making a sale. There is a great need for a simple method of arriving at the grade of cottonseed in small lots. It could not be as scientific as the present method and would need to be based very largely on the average oil content for varieties and areas and on the foreign matter in the seed. Research designed to develop such a simplified method would seem to be very desirable.

The present system of marketing cottonseed is probably the logical result of a situation where a plant produces joint products, one of which is dominant and the other is considered a by-product. In fact, until about 60 years ago, the cottonseed was considered to be a complete waste. A further complication is the fact that the nature of the two products is such that the same marketing system cannot very well handle both products. Another point to consider is the fact that the seed are naturally

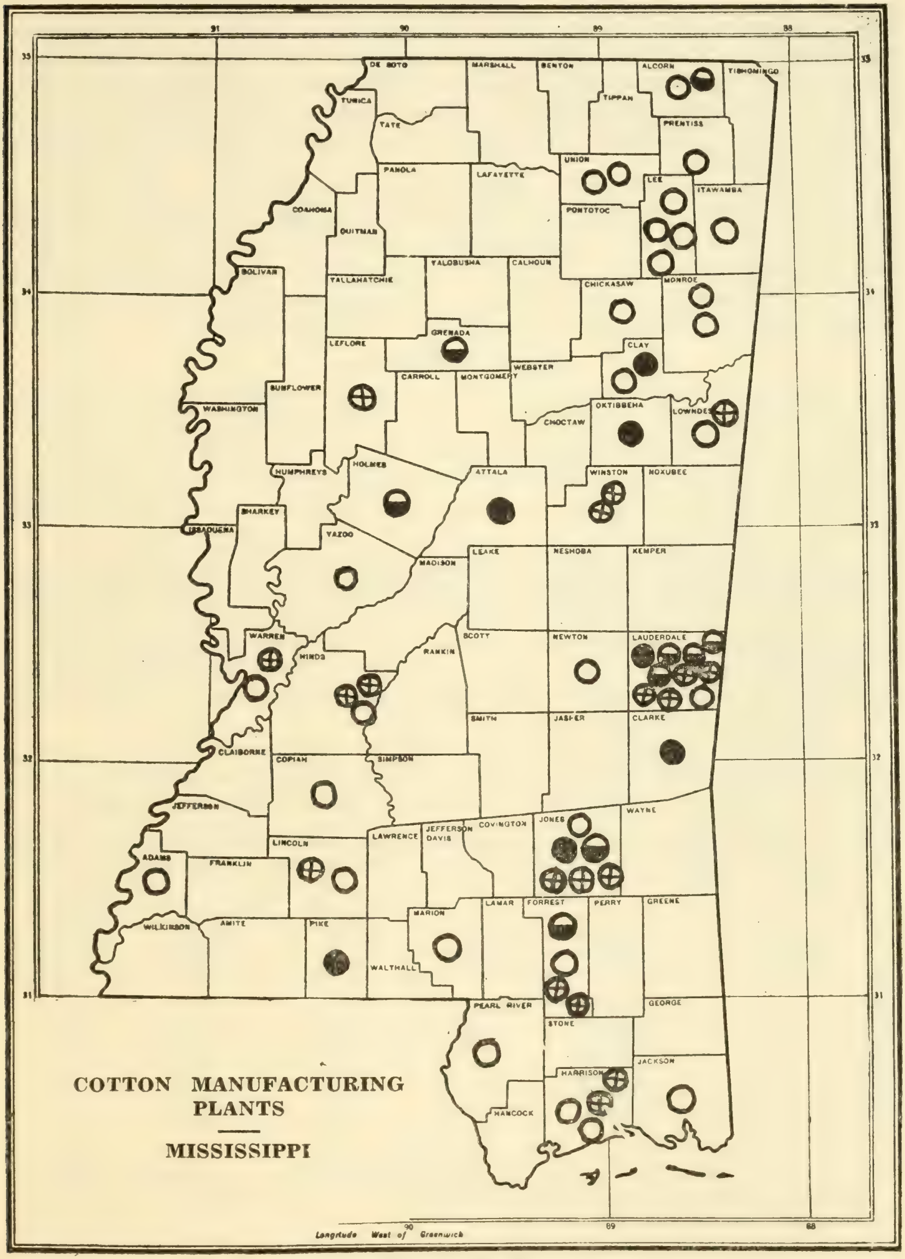

Figure 5. Distribution of cotton mills, hosiery mills, garment and mattress factories in Mississippi, 1942.

● Cotton mills
○ Garment factories
◒ Hosiery mills
⊕ Mattress factories

Source: Mississippi Index of Manufacturers, Miss. Board of Development.

concentrated at the cotton gins and with most of the present ginning equipment, it is rather difficult to separate one producer's seed from another. Furthermore, the movement of the seed from the gins to the oil mills can be done more efficiently when they are concentrated in large lots at the gin. At the gin, therefore, is the logical place for the cottonseed to change hands.

In view of this situation any attempts to improve the present system of handling cottonseed should be based on a thorough study of its advantages as well as its disadvantages and should give careful consideration to the nature of the product being handled. It is very likely that greater progress can be made by systematically improving the present system than by attempting to substitute alternative systems.

Cotton Manufacture

The manufacture of cotton products has never developed to any great extent in Mississippi. According to the Mississippi Index of Manufacturers, there were seven cotton mills including two thread mills operating in the State in 1942. In addition to these there were 29 garment factories, 9 hosiery mills, and 19 mattress factories. The location of these industries is shown in figure 5.

The shift of the spinning industry to the South did not bring any mills to Mississippi. Instead, most of the mills which moved southward went to the Carolinas and Georgia. From 1937 to 1942 there was a steady decline in the number of active cotton spindles operating in Mississippi (table 12). The decrease was from 181,096 in 1937 to 133,840 in 1942. By way of comparison, North and South Carolina each had over 5,000,000 active spindles.

The mills in Mississippi consumed an average of 53,231 bales of cotton during the 6-year period, 1937-1942. This is an average of 3.1 percent of the cotton produced in the State during the same period.

Table 12—Total and active cotton spindles, cotton and linters consumed and the percent the cotton consumed is of the total production, Mississippi, 1937-1942

Year	Cotton spindles		Cotton consumed bales	Linters consumed bales	Percent of total cotton production
	Total	Active			
1937	206,164	181,096	52,821	1,485	2.1
1938	209,016	168,440	38,265	1,282	2.3
1939	165,440	159,440	39,640	1,941	2.6
1940	150,704	150,704	45,058	1,928	3.6
1941	151,830	132,246	86,017	1,569	6.2
1942	138,312	133,840	57,583	1,556	2.9
Average	170,244	154,294	52,231	1,627	3.1

Source: Bureau of the Census, Cotton Production and Distribution, 1939-40, and 1941-42, Bulletins 177 and 179.

LIVESTOCK

CATTLE PRODUCTION

From 1920 to 1928 there was a gradual decrease in the number of cattle and calves on farms in Mississippi (figure 6). On January 1, 1920,

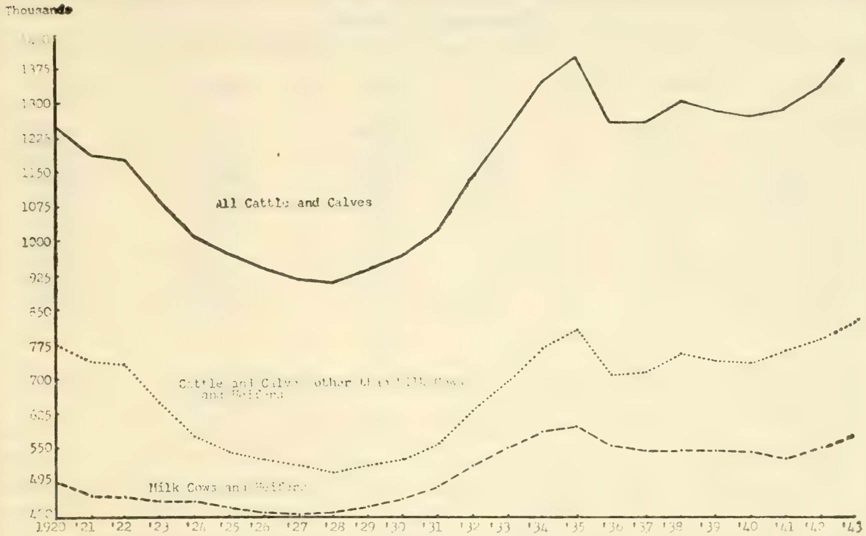

Figure 6. All cattle and calves, milk cows and heifers, and cattle and calves other than milk cows and heifers on farms in Mississippi on January 1, 1920 to 1943.

Source: Livestock, Meats, and Wool Market Statistics and Related Data 1941. AMA, USDA, 1942.

there were 1,250,000 head of cattle and calves on farms in the State, and by the same date in 1928 the number had declined to 912,000 head. There was a decline in all types of cattle, but the reduction was much more pronounced for the cattle and calves kept for beef than for milk cows and heifers.

From 1928 to 1935 there was a period of pronounced expansion of all types of cattle. The increase was greater for beef type animals than for the dairy groups. However, both groups reached their peak in 1935. The number of milk cows and heifers on farms declined to about 500,000 on January 1, 1936, and remained fairly close to that figure until the beginning of the war. During the past 2 years there has been a slight increase, due largely to impetus brought about by the war conditions. The number of other types of cattle has not varied greatly during the past 8 years, but there has been a very slight tendency to increase during this period, especially during the last 3 years. These figures apply to the State as a whole and do not give a picture of what has been happening within the several types of farming areas within the State.

In order to get an indication of the shifts within the State, the census reports for cattle were summarized for the last several periods. It will be noted from table 13 that the number of cows and heifers milked was about the same in 1939 as in 1919 for the Delta, Brown Loam, Clay Hills, Copiah, and Upper Coastal Plain Areas. There were definite increases in the Oktibbeha, Black Prairie, Lower Coastal Plain, and Gulf Coastal

Table 13—Number of cows and heifers milked, by type-of-farming areas, Mississippi, 1909-1939

Area	1919	1929	1939
Delta	43,478	29,735	40,756
Brown Loam	120,748	111,205	122,449
Clay Hills	115,912	104,211	113,682
Oktibbeha	7,640	13,392	16,257
Black Prairie	43,357	49,220	66,210
Copiah	8,091	7,831	8,266
Upper Coastal Plain	17,616	14,853	18,027
Longleaf Pine	62,692	41,683	54,194
Lower Coastal Plain	5,026	8,040	12,061
Gulf Coastal	2,846	3,516	4,585
Total	427,406	383,686	456,487

Areas. The only noticeable decrease was in the Longleaf Pine Area. For the entire State there were a few over 29,000 more milk cows and heifers in the State in 1939 than in 1919. There was, however, a noticeable increase in the number of milk cows and heifers in all areas between 1929 and 1939. In the past it has been characteristic for the number of dairy animals to increase during periods of distress such as wars or low prices of cotton, and to decrease when the emergency was over or when cotton prices went higher. The Oktibbeha and Black Prairie Areas have been exceptions, however, and have consistently increased in the number of dairy animals on farms.

The number of cows and heifers 2 years old and over kept mainly for beef production for the recent census years is shown in table 14. There was a 61 percent decrease in beef cattle, as measured by number of cows and heifers 2 years old and over, between 1920 and 1930. This tendency was reversed during the next decade and between 1930 and 1940 there was a 56 percent increase in the number of cows and heifers kept for beef production. On a percentage basis the greatest increase between 1930 and 1940 was in the Delta. There was a 320 percent increase in this area during this period. Beef cattle had almost completely disappeared from many counties in the Delta by 1930, there being a 78 percent decrease between 1920 and this date. As mentioned before, during the period after the first World War and until the beginning of the government restriction programs, the Delta was becoming more and more specialized in cotton production. It was not until some acreage was forced out of cotton that there was any great amount of feed or pasture produced for livestock. With the increased feed and pasture grown on land taken out of cotton there has been a rather rapid increase in beef cows and heifers. However, because of certain rulings that have been in effect that did not count permanent pasture as cropland, many of the pastures used so far have been of a temporary nature to keep from having the crop acres reduced.

The Brown Loam Area had more cows and heifers of the beef type than any other area, and in numbers had by far the greatest increase

Table 14—The number of cows and heifers 2 years old and over kept mainly for beef production, by type-of-farming areas, Mississippi, 1920-1940[1]

Area	1920	1930	1940
Delta	6,017	1,298	6,748
Brown Loam	95,457	41,429	57,340
Clay Hills	22,658	5,737	11,679
Oktibbeha	942	373	1,265
Black Prairie	11,636	16,402	14,694
Copiah	7,633	5,136	5,525
Upper Coastal Plain	1,627	976	2,166
Longleaf Pine	25,535	8,327	15,710
Lower Coastal Plain	23,535	6,796	10,180
Gulf Coastal	9,579	4,336	5,282
Total	204,619	79,886	124,594

[1] Figures for 1930 and 1940 are the number on hand as of April 1, of each year. Data for 1920 are given for January 1.

between 1930 and 1940. On a percentage basis, however, there was only a 38 percent increase during this period. The Brown Loam Area had 40 percent less beef type cows and heifers in 1940 than in 1920.

In all the other areas, except the Black Prairie, Copiah and Gulf Coast Areas, there were large increases in beef type cows and heifers kept on the farms. In the Black Prairie and Gulf Coastal Areas there were slight declines, while there was only a small increase in Copiah County.

It is recognized that the census figures leave much to be desired in the matter of comparability between census years as well as in the question of total coverage, especially for livestock, but it is believed that for the purpose of showing trends and comparison between areas they are fairly indicative of actual happenings.

The location of beef cow herds in Mississippi in 1939 is shown in figure 7. The cows and heifers 2 years old and over kept mainly for beef production is a good measure of the beef cattle herds in the State. This figure, however, does not give any indication of the areas where feeder cattle are bought and fattened out. The number of cattle sold (as shown in figure 11) gives a better idea of this phase of beef cattle production. The beef cattle herds are concentrated in four areas of the State, the most important of which is the lower part of the Brown Loam in southwestern Mississippi.

There is another area of concentrated beef cattle herds in the northern part of the Brown Loam including parts of DeSoto, Tate, Panola, Marshall, and Lafayette Counties. There is probably a higher proportion of pure-bred breeding herds in this section than any other section of the State.

The third area of concentrated beef herds is in the southern counties of the Black Prairie, including parts of Chickasaw, Monroe, Clay, Oktibbeha, Lowndes, and Noxubee Counties.

The fourth area is the open range, cut-over section of southern Mississippi. The northern part of the area extends up into the Central

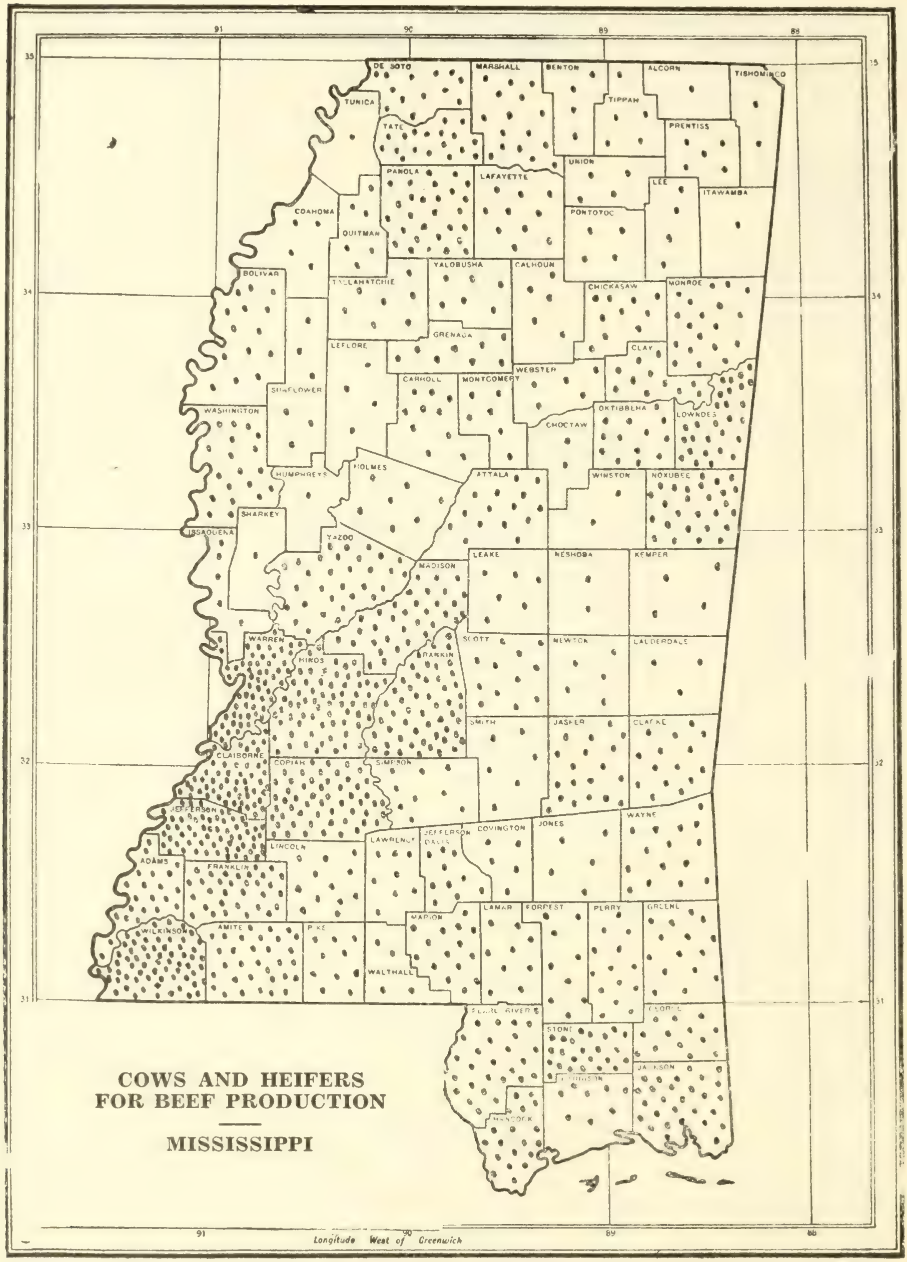

Figure 7. Distribution of cows and heifers 2 years old and over kept mainly for beef production, on April 1, 1940, Mississippi.

1 dot = 100 head

Source: Census of Agriculture, Bureau of the Census, 1940.

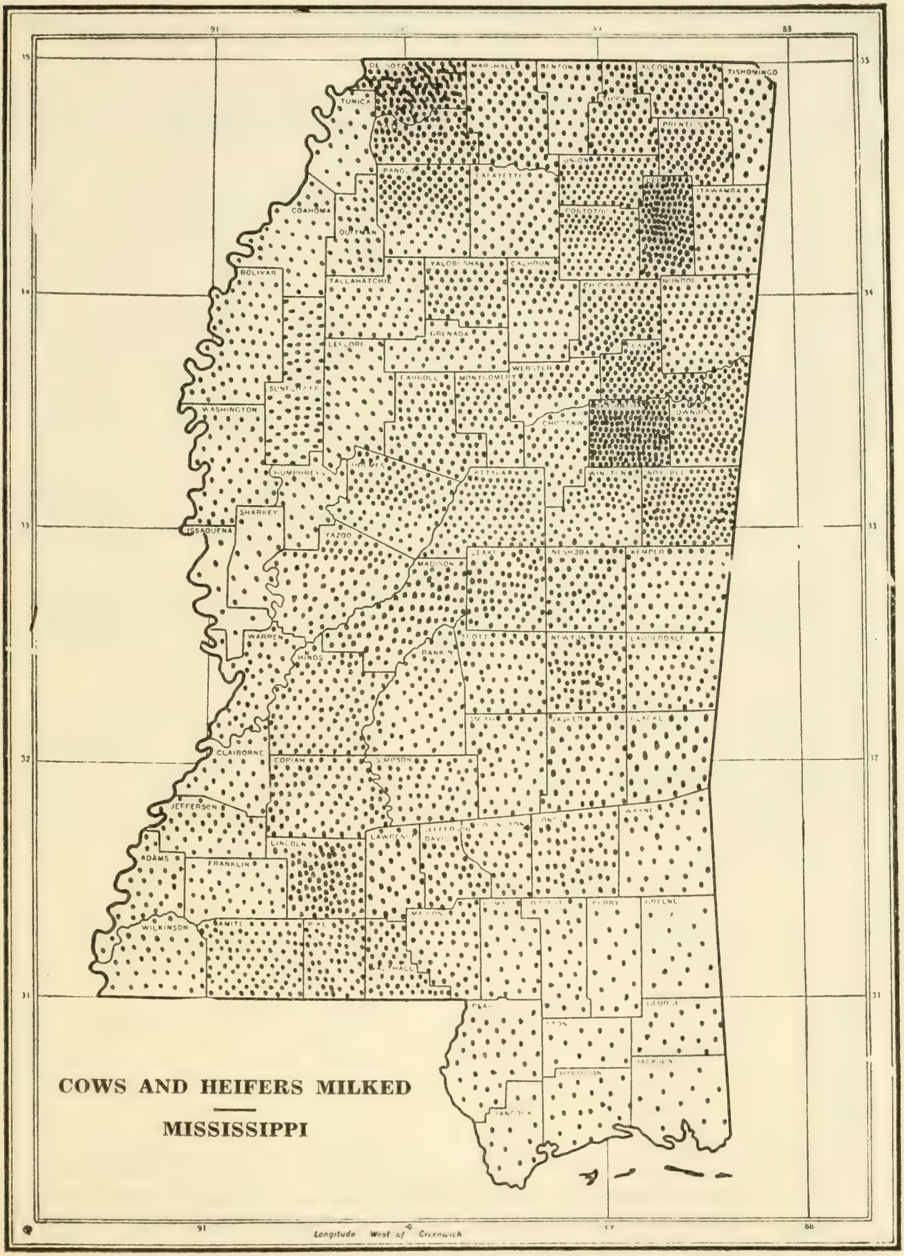

Figure 8. Distribution of cows and heifers milked in Mississippi, 1939.

1 dot = 100 head

Source: Census of Agriculture, Bureau of the Census, 1940.

Prairie and includes all or parts of about 12 counties in southeastern Mississippi.

A more detailed description of the beef cattle enterprises in Mississippi is given in a recent bulletin issued by the Extenson Service of Mississippi State College.[1]

The distribution of all cows milked in 1939 is shown in figure 8. Cows kept for production of milk for home use as well as those producing milk for commercial purposes were included in this figure. It is readily seen that milk cows are rather generally distributed over the State, with definite concentrations in the commercial milk producing areas. The points of heaviest concentration are in the Black Prairie, especially in Oktibbeha and Lee Counties. The counties in the Memphis Milk Shed, particularly DeSoto, also have large numbers of milk cows. Likewise the counties in the southern part of the State that serve the New Orleans market are well supplied with dairy animals.

As will be shown in another section of this report, the dairy cattle are concentrated in those areas where there are established markets for milk and other dairy products.

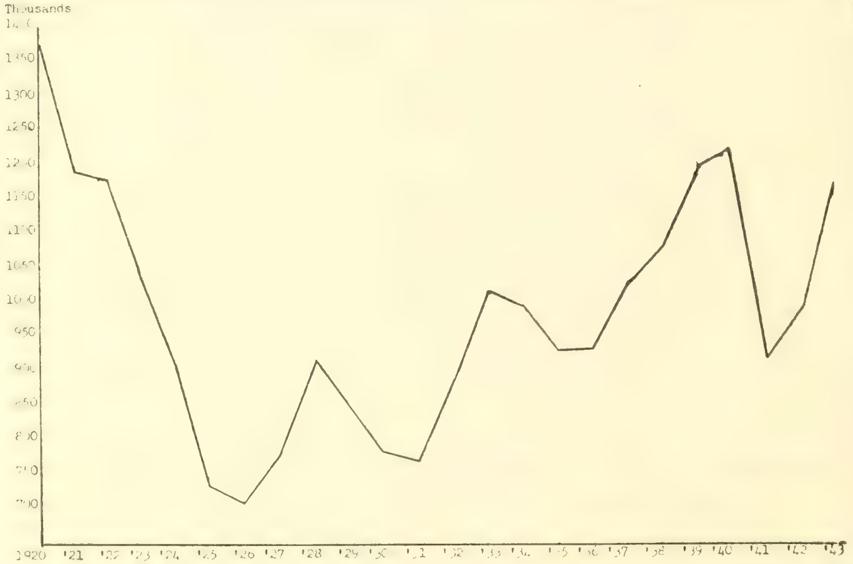

Figure 9. Hogs and pigs on farms in Mississippi on January 1, 1920 to 1943.

Source: Livestock, Meats, and Wool Market Statistics, 1941, AMA, USDA, 1942.

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[1] Newell, Paul F. and Grissom, E. E.: "Beef Cattle Enterprises," Extension Bulletin 118 (30 M), 1942.

HOG PRODUCTION

At the close of the first World War there were more hogs and pigs on farms in Mississippi than there have been at any date since that time. The number of hogs and pigs on farms on each January 1 since 1920 is shown in figure 9. It should be noted that there was a very sharp decline in the number of swine on farms from January 1, 1920, to the same date in 1926. During this 6-year period there was a reduction from 1,370,000 to 700,000 or almost a 50 percent decline in hog numbers.

Since 1926, however, there has been a definite upward trend in the number of hogs and pigs on farms at the beginning of each year. There have been definite cycles of hog production, but the low point in each succeeding cycle has been higher than the previous low point. Normally, the hog cycle is five to six years from peak to peak. With the exception of the long decline after the first World War, the cycles have been regular and uniform in Mississippi for the past 20 years. Since 1941, there has been a large increase in hog numbers in the State and the present indications are that on January 1, 1944, there will be more hogs on farms in Mississippi than at any similar date since 1920.

The census data on hog numbers are not altogether comparable between census periods. However, an indication of the relative importance of the hog enterprise on Mississippi farms can be obtained by a comparison of the number of hogs on farms in the various type-of-farming areas for the most recent years (table 15).

The Delta is the only area in the State that had more hogs on April 1, 1940, than on January 1, 1920. Between 1930 and 1940 there was a 66 percent increase in hog numbers in the Delta. The Clay Hills, Black Prairie, Upper Coastal Plain, and the Longleaf Pine Areas also had increases in hog numbers between 1930 and 1940. On the other hand the

Table 15—Number of hogs and pigs on farms in Mississippi for census years, 1910 to 1930, by areas

Area	Number of hogs on farms			
	1940[1]	1930[2]	1920[3]	1910[4]
Delta	213,853	129,391	196,166	194,383
Brown Loam	235,856	240,315	402,317	437,123
Clay Hills	137,615	124,968	290,502	218,302
Oktibbeha	6,494	7,811	13,919	11,355
Black Prairie	56,950	50,059	119,277	85,639
Copiah	8,960	9,403	18,565	22,587
Upper Coastal Plain	19,987	18,721	48,552	35,155
Longleaf Pine	101,420	87,960	208,799	197,821
Lower Coastal Plain	34,602	48,989	56,815	64,681
Gulf Coastal	10,172	15,164	18,399	25,073
Total	825,909	732,781	1,373,311	1,292,119

[1] April 1, 1940, hogs and pigs over 4 months of age
[2] April 1, 1930, all swine
[3] January 1, 1920, all swine
[4] April 15, 1910, all swine

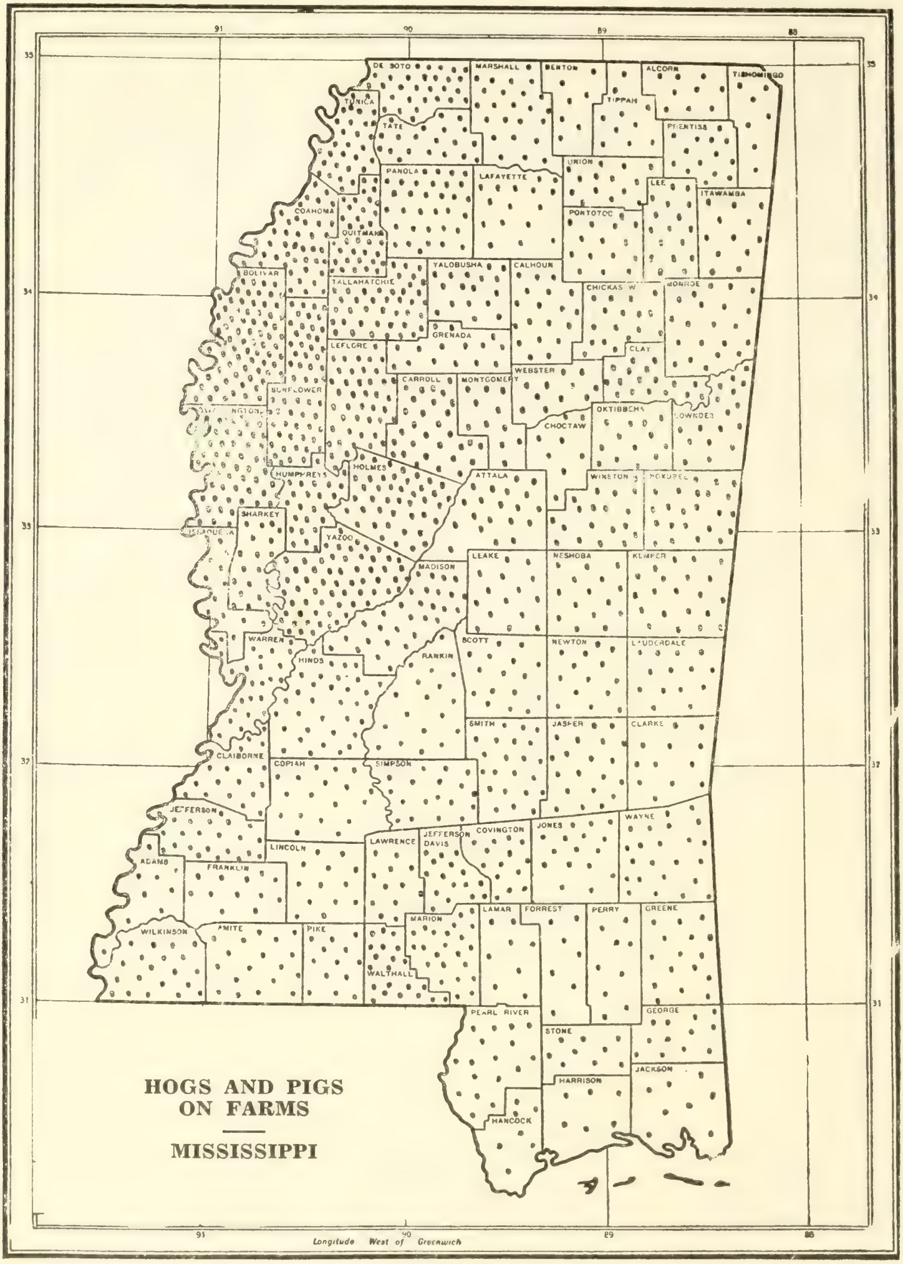

Figure 10. Distribution of the number of hogs and pigs over 4 months old on farms in Mississippi on April 1, 1940.

1 dot = 500 head

Source: Census of Agriculture, Bureau of the Census, 1940.

Brown Loam, Oktibbeha, Copiah, Lower Coastal Plain, and Gulf Coastal Areas all had constant decreases in hog numbers for the past three or four census periods.

There were 56 percent more hogs on farms in Mississippi on April 15, 1910, than there were on April 1, 1940. The distribution of swine on farms in Mississippi on April 1, 1940, is shown in figure 10. The area of greatest concentration is the Delta and some of the surrounding counties in the Brown Loam. Outside of this one concentrated area hogs are scattered fairly uniformly throughout the State. In many sections hogs are kept mainly to raise meat for home use. If prices are high and feed is available, many of the farmers fatten and sell the surplus not needed at home. If feed is not plentiful, many pigs will be sold as feeders.

The hog enterprise on many farms in Mississippi can be increased or decreased as fast as biological forces will allow. That is, many farmers have a brood sow or two around the place whose main purpose is to produce pigs to be used for meat at home. However, if the price of pork is high, it is not difficult for the farmer to keep an extra gilt for an increase in hogs the next year. If prices are low, the number can be reduced as fast as pigs on hand can be put in shape to be sold. For the major portion of the hill section of the State, the hog enterprise takes the form described above. There are, however, some areas that regularly produce hogs on a commercial scale. These areas are shown in figure 13 which gives the distribution of hogs and pigs sold in 1939.

MARKETING

Cattle and Hogs

Because of the fact that cattle, calves, and hogs usually go through the same marketing channels, they will be discussed together in this section. In some cases sheep and lambs are handled on the same markets. However, because of the small number of sheep and lambs sold in Mississippi, they are usually handled in special sales sponsored by the Extension Service of Mississippi State College.

According to the latest census there were 149,116 cattle sold from farms in Mississippi during 1939. The distribution of cattle sold is shown in figure 11. Both beef and dairy cattle are included in this figure. It will be noted that there were relatively few cattle sold in the Delta Area. However, several of the counties in the Brown Loam, surrounding the Delta, sold fairly large numbers of cattle. In addition there were large numbers of cattle sold from farms in the southern counties of the Black Prairie Area. As has already been pointed out, these are counties where there is a large concentration of dairy animals. Therefore, many of the cattle sold in this area are young cows that are being shipped for replacements in other states, or are cows that have been culled from the dairy herds and are being sold for slaughter. Also, there are many grade jersey bulls and steers sold from the farms in these areas.

The livestock industry is important in the open range cut-over area in the southern part of the State, but because of the sparse grazing available, there are fewer cattle sold than in some other areas of the State. There are fairly large numbers of cattle sold in the Longleaf Pine Area

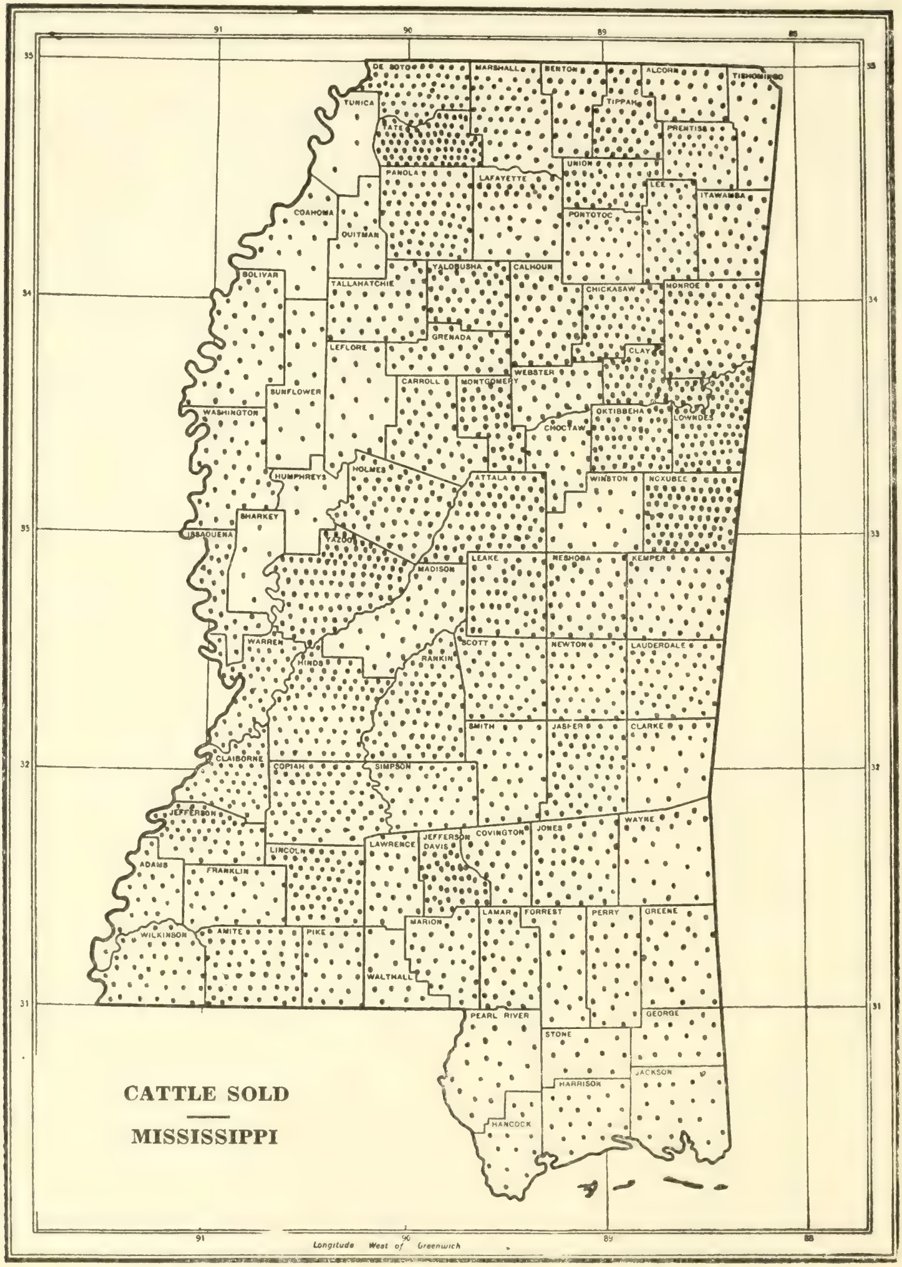

Figure 11. Distribution of cattle sold, Mississippi, 1939.
1 dot = 50 head

Source: Census of Agriculture, Bureau of the Census, 1940.

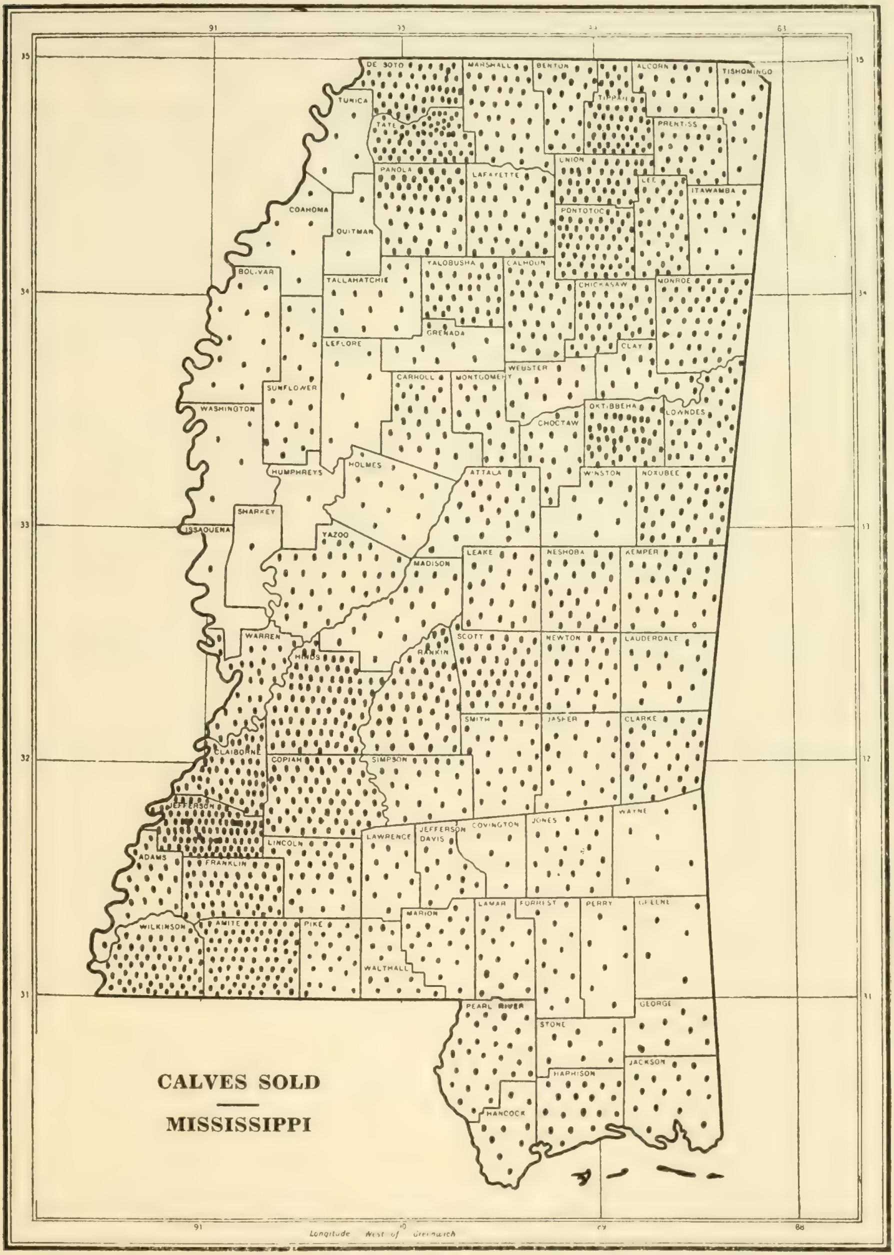

Figure 12. Distribution of calves sold, Mississippi, 1939.

1 dot = 50 head

Source: Census of Agriculture, Bureau of the Census, 1940.

and the southern part of the Brown Loam Area. This latter area is one of the most highly concentrated beef cattle areas in the State, but it is made up largely of cow herds for calf production.

During 1939 there were 104,101 calves sold from farms in the State. The distribution of calves sold is shown in figure 12. It is apparent at once that the sale of calves is concentrated in the southern Brown Loam counties. It is customary in this area to sell the calves born each spring in the fall of the same year. They are sold at from six to eight months of age and go for immediate slaughter as grass and milk fat calves, or are sold as feeder calves. The only other areas where large numbers of calves are sold are the dairy areas of the Memphis Milk Shed and in the Black Prairie and surrounding counties. A large proportion of these are very young dairy calves that are a by-product of the milk producing process.

During 1939 there were 196,302 hogs and pigs sold from farms in Mississippi. The distribution of these sales is shown in figure 13. The sale of hogs and pigs did not follow any type-of-farming area. The greatest concentrations were in Washington, Yazoo, Warren, and Claiborne Counties. However, there were relatively heavy sales in almost all the counties in the northern part of the State. The inclusion of both hogs and pigs does not give an indication of either the fat hog or feeder pig sales.

Except for George County and the counties along the western border, the number of hogs and pigs sold in the southern part of the State were not very large but were fairly uniform throughout this area.

The actual methods of the sale for the various types of livestock are not greatly different from area to area in the State. However, the livestock marketing system has been developing and in recent years has made considerable progress.

Until about ten years ago the livestock of all types produced in Mississippi was sold to local meat markets, local livestock dealers, or in some cases, where there was enough volume, was shipped by truck or by rail to one of the central markets. There were no well-established livestock markets in the State. The stock that was produced in excess of local needs was often shipped by rail to St. Louis, Chicago, Memphis, or some other large central market. Only the large producers and some livestock dealers were able to make such shipments.

Since the early thirties, however, there has developed a system of livestock auction markets that covers almost all the State. There were 40 of these markets operating in 1942, locations of which are shown in figure 14. A majority of these markets hold sales one day per week. A few, however, have sales once in 2 weeks, and in one case only one sale per month is conducted. It will be noted that the only sales in the southeast section of the State are at Laurel and Hattiesburg, with two auction markets in each of these towns. It is necessary for the livestock produced in this area to be hauled considerable distances to market. A part of this stock goes to markets in Mobile, Alabama, and New Orleans, Louisiana.

The northwestern section of the State does not have any local markets.

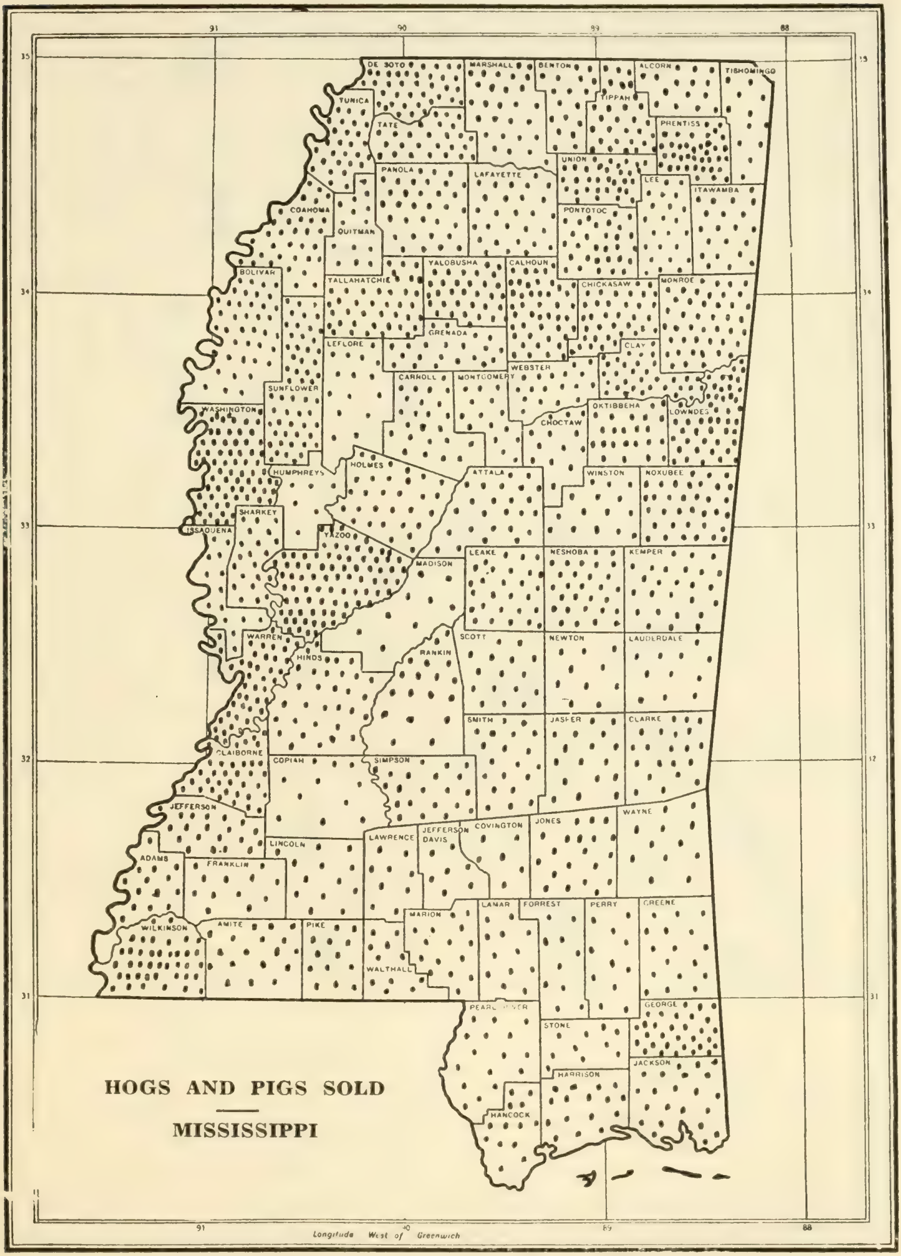

Figure 13. Distribution of hogs and pigs sold, Mississippi, 1939.

1 dot = 100 head

Source: Census of Agriculture, Bureau of the Census, 1940.

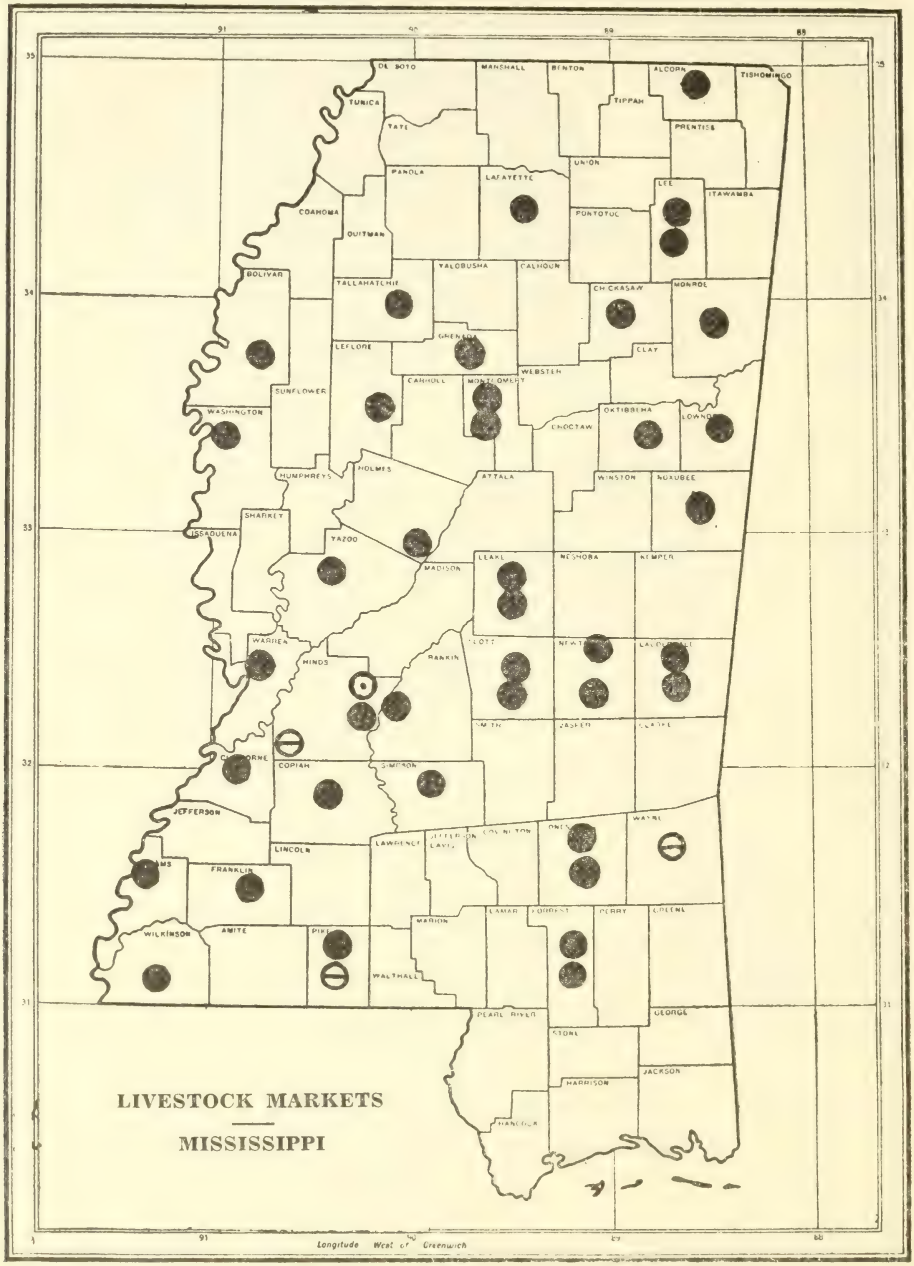

Figure 14. Distribution of livestock markets in Mississippi, 1942.

● Auction markets

⊖ Auctions—not operating

⊙ Central markets

Source: Records of Economics Division, Mississippi Extension Service, and a survey conducted by the author.

Almost all the livestock produced in this area goes direct to the stockyards in Memphis. Producers in this area find that they save enough on commissions to pay them to haul their stock to Memphis.

There is only one central livestock market in Mississippi. The Union Stockyards in Jackson offers a market for livestock on any sale day in the year. No commissions are charged. The stock is bought outright and paid for on a grade basis. The buyers on this market are order buyers and ship their stock almost entirely by rail. Normally, from 1,000 to 1,200 carloads of stock (hogs and cattle) are shipped from this market each year.

The stock is brought to the auction market by farmers and local livestock dealers. At the unloading chute each animal is usually given a number, and a tag bearing the number is fastened in the animal's ear. At most markets the number, or numbers, and the owner's name are recorded on a ticket and passed to the auctioneer's table as the animals enter the ring. As the stock is sold, the person keeping the records of the sale records the price. If the animals are sold by weight, the ticket is then passed to the weigh master who records the proper weights. Next the ticket is carried to the main office of the auction sale where the record is completed, the commissions deducted, and the checks made out. There are many variations to this system but in general the sales follow a fairly uniform procedure. The most efficiently operated auctions have the records completed and the check ready for the consignor a few minutes after the auctioneer declares the sale.

The operator of the sale usually acts as the ringmaster and when the stock comes into the ring, he usually starts the bidding. To properly perform this function, he must know livestock and livestock prices. It is up to him to start the bidding at a point low enough that he will not have to buy the stock and yet high enough to insure the consignor the best possible price. The success of the auction sale depends upon the ability of the manager to satisfy both the seller and the buyer. Almost all the auction market operators are, in addition, livestock dealers. They buy stock and sell it at their own auctions, or they buy at their own auctions and resell at a later date on their own markets, or take the stock elsewhere for sale. Many market operators go to other auction markets in the State and buy stock to sell direct to farmers in their community or to sell in their auction rings.

The auction sales usually have a definite order in which they sell each type of livestock. That is, all the hogs will be sold, then cattle, and finally, horses and mules. Other sales may use a different order. It is the usual practice to sell slaughter and feeder stock by weight. All the sales that were operating in 1942, with the exception of two that were open only part of the year, were equipped with scales. The usual practice is to weigh animals which sell by weight after they leave the auction ring. Dairy cows and heifers, breeding stock, small pigs, and miscellaneous stock, such as kids and goats, are commonly sold by the head.

The animals are not mixed as to ownership, but when one consignor has several animals that are different in type, the ring masters usually make some attempt to sort the stock into fairly uniform groups. In most cases very little attempt is made to sort the stock, particularly hogs, before they go into the ring. It was noted frequently that a bunch of hogs ranging from very small pigs to fat slaughter hogs would all be run into the ring. The ring master would pick out two or three of the best fat hogs and sell them. They would then be separated from the group and passed out of the ring. Successive selections and sales would be made until all the group were sold. Often the same practice was followed with cattle.

The stock sold at the auction markets is bought by a variety of persons. Many farmers buy replacements at these sales. Local dealers, order buyers, and representatives of packing plants, are the most important buyers. Some of the smaller markets do not have sufficient volume of any particular type of stock to attract outside buyers, and it follows that the only buyers at these markets are the farmers and local dealers. But the larger markets attract the order buyers, large dealers, and representatives of the packing plants.

Along with the development of the livestock auction market has come an increase in the number of livestock dealers or traders. On the basis of permits granted by County War Boards, there are around 1,600 such dealers in Mississippi. This is an average of about 20 dealers per county. Some counties have as high as 60 dealers. The livestock buyer usually has a pickup truck with high sideboards, and in many cases goes from farm to farm to buy stock and assemble it until sale day. Many livestock dealers are farmers and spend only a part of their time dealing in livestock.

For the most part these dealers perform a necessary service, but the same service could probably be done by a smaller number of persons. A large proportion of the farmers who produce livestock in Mississippi are small operators having only a few head of stock to sell each year. It is not economical for them to own a livestock truck to carry the few head they have to market. Therefore, they have to hire someone to do the hauling or sell outright to a dealer who is equipped to handle the stock. It appears that a large number of these small farmers prefer to sell outright to the dealers. Almost all the trading between the producer and the dealer is on a per head basis. The dealer makes his return by being able to judge correctly the weight of the animals he is buying, because he usually buys by the head and sells on a weight basis.

Many of the livestock dealers buy stock at the auction markets and resell to farmers in their community, or take it to other auction markets, or packing plants, or to the central markets. There is considerable evidence of speculation by the livestock dealers. That is, at almost every sale there are one or more buyers who just sit and wait for what appears to them to be a bargain. At dull points in the sale during the course of an afternoon, they may pick up two, three, or a half dozen animals.

Between many of the smaller auctions and the larger auctions, central markets, and packing plants, this speculative buying is a necessary part of the system because, as mentioned previously, the smaller auction sales cannot attract large livestock buyers. Consequently, the stock from the small sales has to be assembled at larger sales so there will be enough volume to attract the large buyers, who have to be assured of enough stock to allow for economical transportation before they will enter a market. The livestock dealer performs this service of assembling.

This is not to say that it takes all the nearly 1,600 persons that are dealing in livestock in Mississippi to perform this service. There is probably an excess amount of buying and selling on markets of about equal size. Some animals are "worn out" by being hauled from market to market. The fact that an animal can be bought on one market today and sold at a profit on a nearby market of equal size tomorrow is evidence that it did not bring its full value at the first sale. In addition, there are probably too many dealers running around over the country from farm to farm buying livestock. However, the exact nature of the service being performed and the costs involved have not been determined. Definite statements about the performance of this function and suggestions for its improvement cannot be made without making an analysis of the system as it is now operating in more detail than was possible in a preliminary descriptive study.

The usual charge for selling livestock at the auction markets in Mississippi is 5 percent of the gross value of the animals sold. Many markets add to this a small per head charge for yardage, usually 10 cents per head. However, some markets in the eastern part of the State charge 5 percent commission and in addition charge 25 cents per head yardage, 5 cents for weighing, and 2 cents per head for insurance. For small sales where several animals are involved, this amounts to from 6 to 8 percent of the value of the animals. For example, suppose a farmer had 10 feeder pigs that sold for $10.00 each or a total sale value of $100.00. The charges would be as follows:

$100.00 x 5% = $5.00
10 pigs x 25c = 2.50
10 pigs x 5c = .50
10 pigs x 2c = .20
Total = $8.20

The total equals $8.20 or 8.2 percent of the total value of the 10 pigs. If only one animal was involved in the hundred dollar sale, the total charge would be only 5.3 percent of the sale value.

The usual charges for selling livestock on the auction markets in the neighboring states of Louisiana and Arkansas are 4 percent of the sale value plus a small yardage fee that ranges from 5 to 20 cents per head.[1] Sixty-four percent of the markets in Louisiana charged 4 percent or less for auction selling.

In a study of livestock auctions in the United States made by the Farm Credit Administration, it was found that 89 of the 176 auctions reporting charged a percentage of gross sales.[2] Sixty percent of those making their charges on a percentage of gross sales basis charged 3 percent and 17 percent charged 4 percent. Many other references to studies of charges for auction selling could be given, but these are sufficient to show the range of commissions charged.

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[1] Baker, J. M.: "Louisiana Livestock Auction," L. S. U., Agricultural Economics Department, Mimeographed Circular No. 10, 1940, p. 8; Osgood, O. T., and White, J. W.: "Livestock Auctions in Arkansas," Arkansas Agricultural Experiment Station, unpublished manuscript.

[2] Randall, C. G. and Mann, L. B.: "Livestock Auction Sales in the United States," Farm Credit Administration, Bulletin No. 35, 1939, p. 65

Almost without exception these studies show that the usual commissions are 3 to 4 percent of the gross sales plus a small yardage fee, usually from 5 to 20 cents per head. As has already been pointed out, almost all the markets in Mississippi charge a 5 percent commission plus a similar or larger yardage fee.

From information obtained from 20 of the 40 auctions in Mississippi, it was estimated that the total volume of livestock sold on all markets in 1942 amounted to about $20,000,000 or an average of about $500,000 per auction. About three-fourths of this amomunt was from cattle and the other one-fourth from hogs. This does not mean that there was a farm income of twenty million dollars from auction-marketed livestock in 1942, because many animals go through the sales two or three times during a year. Dealers carry stock from one sale to another, and in addition, feeder stock is sold in large numbers in the winter and early spring and is sold again in the fall as fat stock. It is not possible to eliminate these duplications. Consequently, the estimate given is the total dollar volume of business done by all the markets operating in 1942 and is therefore a rough indication of the gross sales value of livestock sold at the auction markets.

If a commission charge of 5 percent is applied to this gross sale value, it amounts to a total of about a million dollars, or an average of around $25,000 per auction market per year. It should be pointed out immediately that this is only an estimate of the average gross income in 1942 of the auctions operating in the State and does not in any way reflect the profitableness of the operation. The costs of operating these markets are not known and no statement about the net income can be made until reliable cost data are available.

The average income and expenses of 28 large auctions scattered over the country were obtained by the Farm Credit Administration for 1937.[3] These auctions handled livestock with an average gross value of slightly over a million dollars. They were considerably larger than the average market operating in Mississippi in 1942, but were no larger than several of the big markets in this State. The 28 markets studied had an average gross income from all sources of $28,147. All expenses including salaries and wages averaged $23,836 per auction. The average net income was $4,311. The total income on these markets including commissions, feed and bedding, yardage, and all other income amounted to an average of 2.5 percent of the gross sale value of livestock handled. The total expenses amounted to 2.3 percent of the gross sale value of livestock sold. Thus, the net operating margin was .2 percent of the sale value.

One auction in the State is owned cooperatively by a group of livestock producers. The facilities were put up at a total cost of $10,600. The completed market was then leased to one of the members who operates it the same as any other market. The members who furnished the original capital can sell any amount of stock they want to at any sale for a 3 percent commission. Any non-members who use the market are charged from 3 to 5 percent, depending on the volume sold. This market started operating in October of 1941 and has held two sales each month since that date.

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[3] **op. cit., p. 105**

The auditor's report for the first 17 sales conducted at this market shows that the average commissions paid for these first sales amounted to 3.5 percent of the gross sales. The total costs of operation amounted to 2.96 percent of the gross sales. In other words, there was a net income of .54 percent of the gross sales. During the first 18 months of its operation this market handled about $1,400,000 worth of livestock. On this basis, the net income for this market would have been $7,560 for the 18-month period or at a rate of $5,040 per year. This amount of net income was based on an average commission charge of 3.5 percent.

However, these figures are for only one market and cannot be considered as representative of the livestock markets in the State. They are given only as a statement of what has been accomplished at this one market.

There seems to be general agreement among farmers and livestock dealers that the development of the present system of auction markets has done much for the livestock industry in the State. These markets have many advantages. They have brought a ready cash market for almost every type of livestock within reach of a majority of the farmers in the State. They bring the producer and the buyer together and thus contribute to a better understanding of the problems of each by the other. Many persons mentioned their educational value. Farmers who attend the sales see the premiums paid for the better stock and learn the characteristics possessed by these good animals.

On the other hand, there are certain very obvious disadvantages to the markets as they are now operated. One of the most serious drawbacks is the spread of disease, particularly hog cholera. In some instances the hog markets have been almost completely destroyed because of a cholera epidemic that could be traced directly to the market. Some unscrupulous dealers and producers have been known to carry exposed or infected hogs and sell them in the auction rings. Unfortunately, there are no effective means in the hands of the State sanitary authorities for dealing with such cases. Actually, the only safe thing for any farmer to do who buys hogs to carry to his place is to have them vaccinated immediately and not put them with other stock until he is sure they are sound.

The disease problem, however, is not confined to the auction markets. There is always danger from communicable diseases where stock is assembled. It would seem, then, that all due precautions should be taken at each assembly point to keep the spread of disease as low as possible. The contrary to this situation is the rule in Mississippi. No effective supervision of any kind is provided for by State statute. As a result not many operators do any cleaning or disinfecting between sales. Many of the markets looked as though they had never been cleaned.

Another objection to the auction sales as they are operated in

Mississippi is the rough treatment the animals receive. It was observed at many markets that cows and hogs were beaten badly by rough handlers who hit them with sticks or boards. Few people realize the damage done to a fat hog when he is hit across the ham with a stick. There is usually a large bruised place that is a total loss when the animal is slaughtered. The same applies to fat cattle. The walking cane serves its purpose as the symbol of the stockman, but it should never be used to hit an animal except in self protection. A harmless quirt made of some material such as a small piece of rope that will sting the animal will do the job just as effectively as a stick, and it will do no damage to the animal.

Selling on many of the markets is slowed up by groups of people in the auction ring. Often there are so many people in the ring that the buyers cannot see the animals. The stock gets frightened, and will not enter the ring, or if it does, runs around, among and behind the spectators where the real buyers cannot see it. Often the pigs have to be chased around and around among the people in the ring before they can be caught and passed out to the scales after they are sold. Part of this congestion in the ring is due to a lack of seating facilities to accommodate all the people who usually attend the sales. Many sales have very poor seating and ring arrangements, and in others where there is ample seating space, the crowds still fill the ring. It would seem to be the part of wisdom to have the seats near the ring reserved for buyers, and allow no one in the ring except the necessary handlers. Those who come just to see should not be allowed in the ring or in the buyers' seats, but should be provided seats back away from the ring where they can observe without interfering with the efficient operation of the sale. With such an arrangement, the auctioneer could give his attention to the buyers and catch all the bids. In some cases it was observed that bids were missed and the stock sold for less than it would have been if all the bids could have been registered.

There are many other points about the auction markets that should be considered. There is danger of getting too many markets in some areas so that they become merely farmers' and dealers' trading posts. There are several small towns in the State at present where there are two markets operating with hardly enough volume to support one. Regular, expert testing of scales should be provided. The practices of auctioneers buying on their own account, or market managers buying and reselling on their own market as well as many others, should be thoroughly examined.

As already mentioned, these markets have meant much to the livestock industry in Mississippi, but it is likely that their continued successful performance of the marketing services will depend upon their ability to rid themselves of some of their most objectionable features. Their most severe test is likely to come in the adjustment period at the close of the war. A thorough and objective analysis of the operations of a sample of these markets with the view of helping them improve their services and get in a better position to meet the coming adjustment period would seem to be a worthwhile contribution to the livestock industry in the State.

There is no reliable basis for estimating the proportion of the total livestock sold in the State that goes through the auction markets. Many of the large producers of better quality cattle and hogs follow the practice of selling direct to the large markets in the nearby states and some ship in carload lots to more distant markets. Often the large producer has enough volume to pay him to own his own truck, or to hire a truck to haul his stock to market. However, there are only a very few areas in Mississippi where there are producers large enough to economically perform this service for themselves. Many of them who own trucks do custom hauling for their neighbors.

In addition to the regular auction sales a number of special sales are held each year. The Extension Service of Mississippi State College and the State Livestock Association sponsor a series of livestock shows and sales each year, and also a series of special fall sales of fat and feeder calves. For the most part, the animals sold at these sales are produced by members of the 4-H Clubs and Future Farmer organizations, and the sales are held mainly for their educational value. The stock is all graded and sold at auction on a grade basis.

Mississippi has become noted for its fine herds of Jerseys and consequently, has a developing demand for breeder and replacement stock. In order to get an indication of this demand, the records of animals shipped out of the State were tabulated from the health certificates issued by the Mississippi Livestock Sanitary Board. These records show that approximately 18,510 animals were shipped from the State during 1942 for which health certificates were issued (table 16). Because of incompleteness, some of the certificates were not usable, and it is possible that the total might reach 20,000. Animals going into Alabama have

Table 16—Number, origin, and destination of livestock shipped from Mississippi that were given health certificates by the Livestock Sanitary Board in 1942

Destination State	City of origin								
	Meridian	Tupelo	Okolona	Starkville	Winona	Natchez	Columbus	Others	Total
Alabama	5,088	28	1	2,739			302	175	8,333
Arkansas		34		9	32			53	128
Florida	154	381	40	213				13	801
Georgia	54			6				53	113
Illinois		475			71		607	69	1,222
Indiana							137	5	142
Iowa		23						3	26
Kentucky	446	808	3,382	65	110	511	165	49	5,536
Louisiana	58	170		9		417		338	992
Minnesota						320			320
Missouri		44	16		62			7	129
Ohio					70				70
Tennessee	126	78			125		90	69	488
Texas	35							70	105
Wisconsin		53						16	69
Others								36	36
Total	5,961	2,094	3,439	3,401	470	1,248	1,301	956	18,510

to have an inspection showing that they are free from ticks. For this reason, a large proportion of the stock that was shipped from Starkville, Columbus, and Meridian into Alabama were issued a certificate stating that they were free from ticks and were going for immediate slaughter.

It will be noted that relatively large numbers of cattle were shipped from Starkville and Meridian into Alabama. Almost all of this stock went for immediate slaughter. For instance, the cattle from Meridian went mainly to slaughtering plants in Birmingham, Tuscaloosa, Montgomery, Demopolis, and Greensboro. From Starkville the stock went largely to packing plants at Tuscaloosa, Bessemer, and Greensboro. In addition to the cattle, about 600 head of slaughter hogs went from Starkville to these plants. All these hogs were hauled by truck and about 77 percent of the cattle that went from Starkville into Alabama also were hauled by trucks. The other 23 percent or about 12 carloads were shipped by rail. From Meridian 39 percent of the cattle went into Alabama by rail and the remainder by truck.

A large proportion of the cattle that went to all the other states were Jersey breeding or replacement stock. For the State there were around 12,000 head of this type of stock shipped out in 1942. Almost all of these were either young Jersey cows or springer heifers. For instance, the 3,382 cattle that were shipped from Okolona into Kentucky were almost all 1- to 2-year-old Jersey heifers. On the other hand, a large proportion of the cattle that went to Florida from various points in the State were 3- to 4-year-old cows.

The widespread demand for these dairy animals indicates that there is an opportunity for many dairy farmers in Mississippi to produce and sell a limited number of good quality Jersey heifers each year. Of course, it would be foolish for any farmer to sell his best young stock, but if he can take care of his own replacements, and in addition raise some to sell, he can certainly supplement his income by so doing.

There are six packing plants in the State. They are located at West Point, Tupelo, Jackson, Clarksdale, Greenville, and Meridian. All of these plants slaughter stock that is consumed within the State. They do not enter into interstate trade and are not subject to Federal supervision. All except two of these plants slaughter almost entirely for use in the city where they are located. In addition to these plants there are many local and farm slaughterers who provide meat for the markets in almost every town in the State. No information is available that gives the extent of this market for livestock. There are no Federally inspected packing plants or slaughter houses in Mississippi.

The only Federal supervision that affects the livestock industry within the State is that which is given to five of the auction markets that have been posted as provided by the Packers and Stockyards Act. This act provides that any market which has as much as 20,000 square feet of space in pens and other facilities, exclusive of runways and alleys, shall be posted and supervised as provided in the Act.

Dairy Products

It is estimated that there were 1,359,000,000 pounds of milk produced in Mississippi in 1942. Of this amount the equivalent of 673,000,000

Table 17—Sales and value of dairy products in Mississippi, 1942

Item	Quantity	Price per unit	Value of sales
Farm butter sold, lbs	1,300,000	$ .32 lb.	$ 416,000
Butterfat sold, lbs.	5,680,000	.39 lb.	2,215,000
Milk sold wholesale, lbs.	461,000,000	2.60 cwt.	11,986,000
Milk and cream retailed, qts.	22,000,000	.114 qt.	2,508,000
Combined sales of butter, cream, and milk, lbs.	673,000,000	2.54 cwt.	17,125,000
Value of milk products consumed in household			$17,069,000
Gross farm income from dairy products			$34,194,000

Source: Agricultural Statistician, Bureau of Agricultural Economics, Gulfport, Mississippi.

pounds were sold in the form of butter, cream, or milk. The milk manufacturing plants received the equivalent of 386,876,000 pounds or 57.5 percent of the milk sold, for which they paid a total of $8,951,200. This was an average of $2.31 per hundredweight. The milk delivered to the manufacturing plants was used as follows: 23 percent for butter, 31 percent for evaporated and condensed milk, 33 percent for cheese, and 13 percent for ice cream. In terms of finished products the following were produced in Mississippi in 1942: butter, 4,160,451 pounds; evaporated and condensed milk, 59,414,850 pounds; cheese, 10,474,744 pounds; ice cream, 3,120,772 gallons; and dried or powdered skim milk and buttermilk, 1,508,272 pounds.

The quantities and values of the various dairy products sold in 1942 are shown in table 17. Only about half, or about 673,000,000 pounds, of milk produced was sold. This is the combined sales of milk, cream, and butter converted to a whole milk equivalent. The average value per hundredweight of milk was $2.54 or a total sale value of $17,125,000. For the most part Mississippi farmers sell milk at wholesale and the price is based on a hundred pounds of milk. During 1942 there were 461,000,000 pounds of milk sold at wholesale. This is 68.5 percent of the combined sales of butter, cream, and milk. The milk sold at wholesale brought an average price of $2.60 per hundred pounds. This milk is sold both to the manufacturing plants and to wholesale dealers who distribute retail milk. The milk that goes for retail distribution has to be of higher quality than the milk for processing, consequently the retail milk brings a higher price. This accounts for the fact that the average price for all wholesale milk is higher than the price of that which goes to the processing plants.

There has been a marked increase in the sale of milk from farms in Mississippi during the past 30 years (table 18). Almost without exception the gallons of milk sold have increased in each area for each 10-year period since 1909. However, the most noticeable increase was during the decade from 1919 to 1929. During this period there was an increase

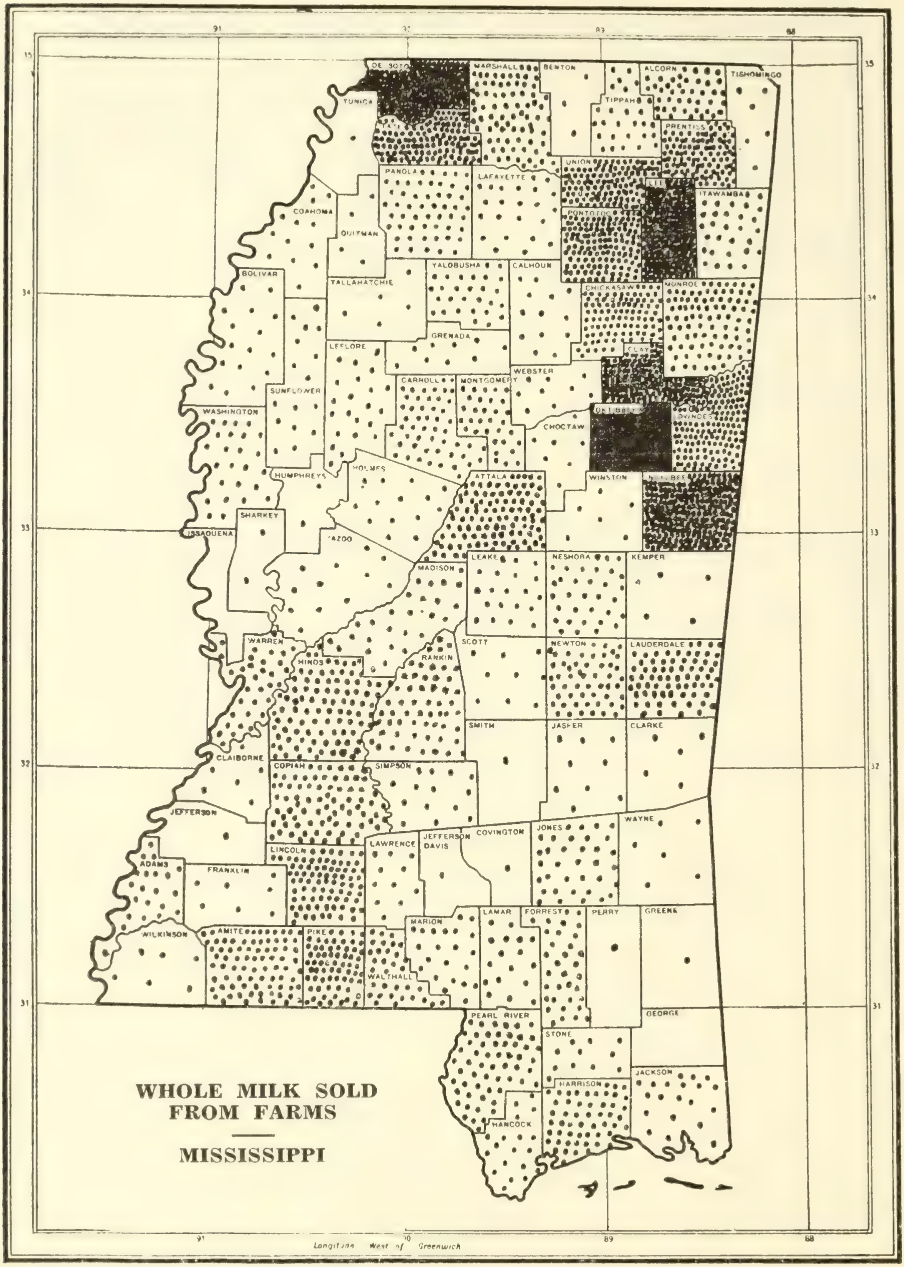

Figure 15. Distribution of whole milk sold from farms in Mississippi, 1939. 1 dot = 10,000 gallons

Source: Census of Agriculture, Bureau of the Census, 1940.

Table 18—Gallons of whole milk sold from farms in Mississippi by type-of-farming areas, 1909, 1919, 1929, and 1939

Area	Amount of milk sold 1939 Gallons	1929 Gallons	1919 Gallons	1909 Gallons
Delta	1,060,753	772,640	271,097	117,372
Brown Loam	10,756,163	9,106,242	1,950,435	1,047,412
Clay Hills	6,928,044	5,047,339	541,727	263,547
Oktibbeha	3,537,938	2,397,255	15,358	7,613
Black Prairie	11,237,401	6,356,856	226,264	113,421
Copiah	669,827	785,131	168,697	17,048
Upper Coastal Plain	1,250,218	1,086,089	56,688	44,863
Longleaf Pine	2,083,443	1,697,867	511,059	82,859
Lower Coastal Plain	1,052,604	467,492	187,369	82,495
Gulf Coastal	917,858	628,950	165,112	189,467
Total	39,494,249	28,345,861	4,093,806	1,966,097

Source: Census of Agriculture, Bureau of the Census, 1909, 1919, 1929, and 1939.

of 592 percent in the gallons of whole milk sold. In 1939 there were 39,494,249 gallons of milk sold in the State. This is a total of about 340 million pounds. In addition, farmers sold around 2,392,000 pounds of butterfat in the form of cream, or an equivalent of about 53 million pounds of 4.5 percent milk. Besides the milk and cream sold, Mississippi farmers made and sold 1,565,595 pounds of butter during 1939.

The distribution of whole milk sold in 1939 is shown in figure 15. A glance at this figure shows that the production of milk for sale is concentrated in several areas. The most important area is the Black Prairie, in which area the heaviest concentrations are in Oktibbeha, Lee, Noxubee, and Clay Counties. The majority of the milk produced in this area is sold to processing plants. Likewise, the milk produced in Attala and surrounding counties, and in the Lincoln County area goes to processing plants. The highly concentrated production in DeSoto, Tate, and Marshall Counties goes to Memphis for consumption as fluid milk. The New Orleans market is served by counties in the southern part of the State. Within the State there are concentrations of milk production around the larger cities such as Jackson, Meridian, Greenville, Laurel, Hattiesburg, and Gulfport.

The sale of butterfat in the form of cream is concentrated in some of the Black Prairie and Clay Hill counties. The distribution given in figure 16 shows a heavy concentration in Oktibbeha and the surrounding counties. A large number of the Clay Hill counties sell considerable quantities of cream. The type of facility available will usually determine the type of product that is produced. If these two figures (figures 15 and 16) are looked at together, it is readily seen that a large part of the milk and cream sold in Mississippi is produced in the northeastern portion of the State.

The distribution of the milk processing plants that operated in the State in 1942 is shown in figure 17. It will be observed that the creameries are usually located in or near the counties where the most cream is

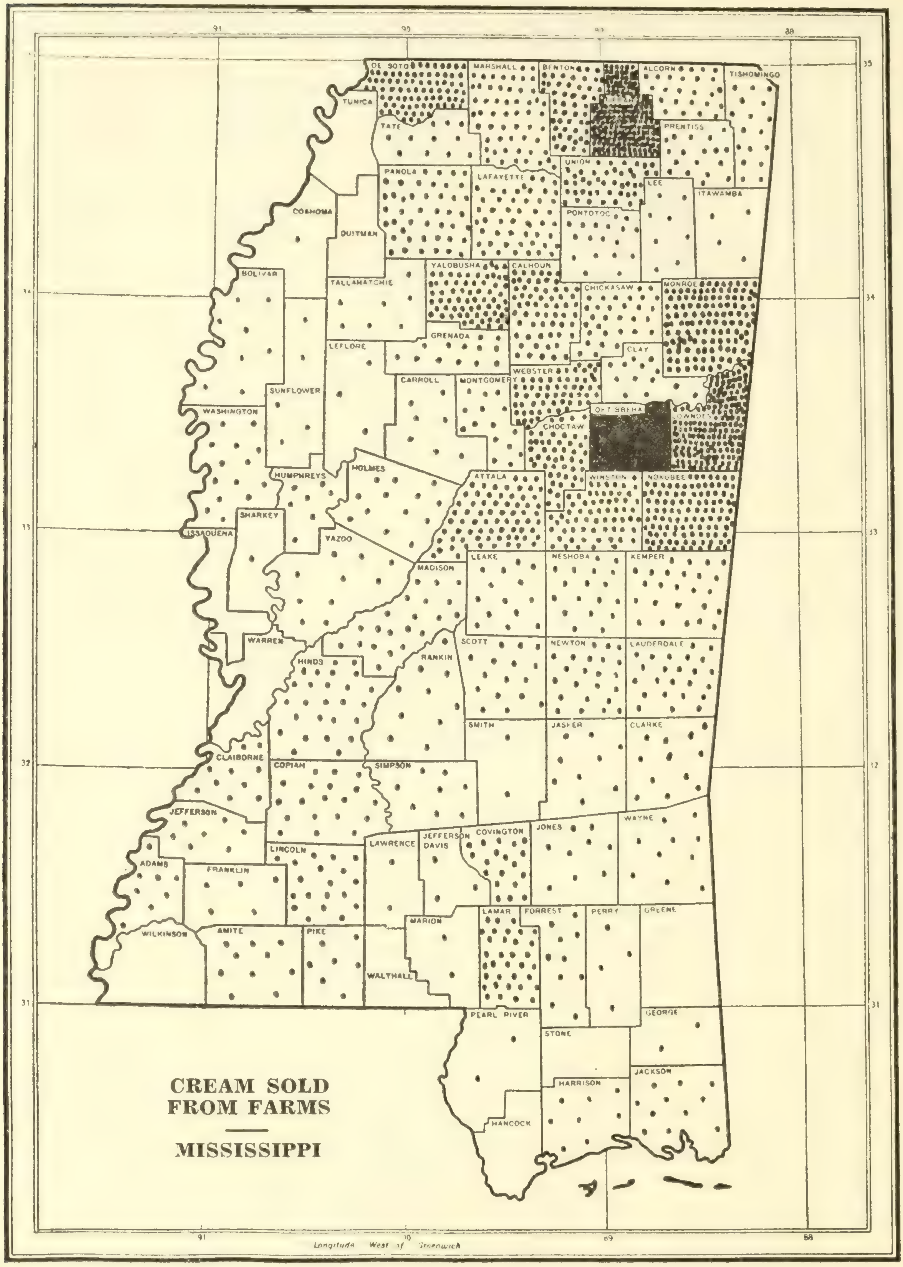

Figure 16. Distribution of cream sold from farms in Mississippi, 1939.

1 dot = 1,000 pounds of butterfat

Source: Census of Agriculture, Bureau of the Census, 1940.

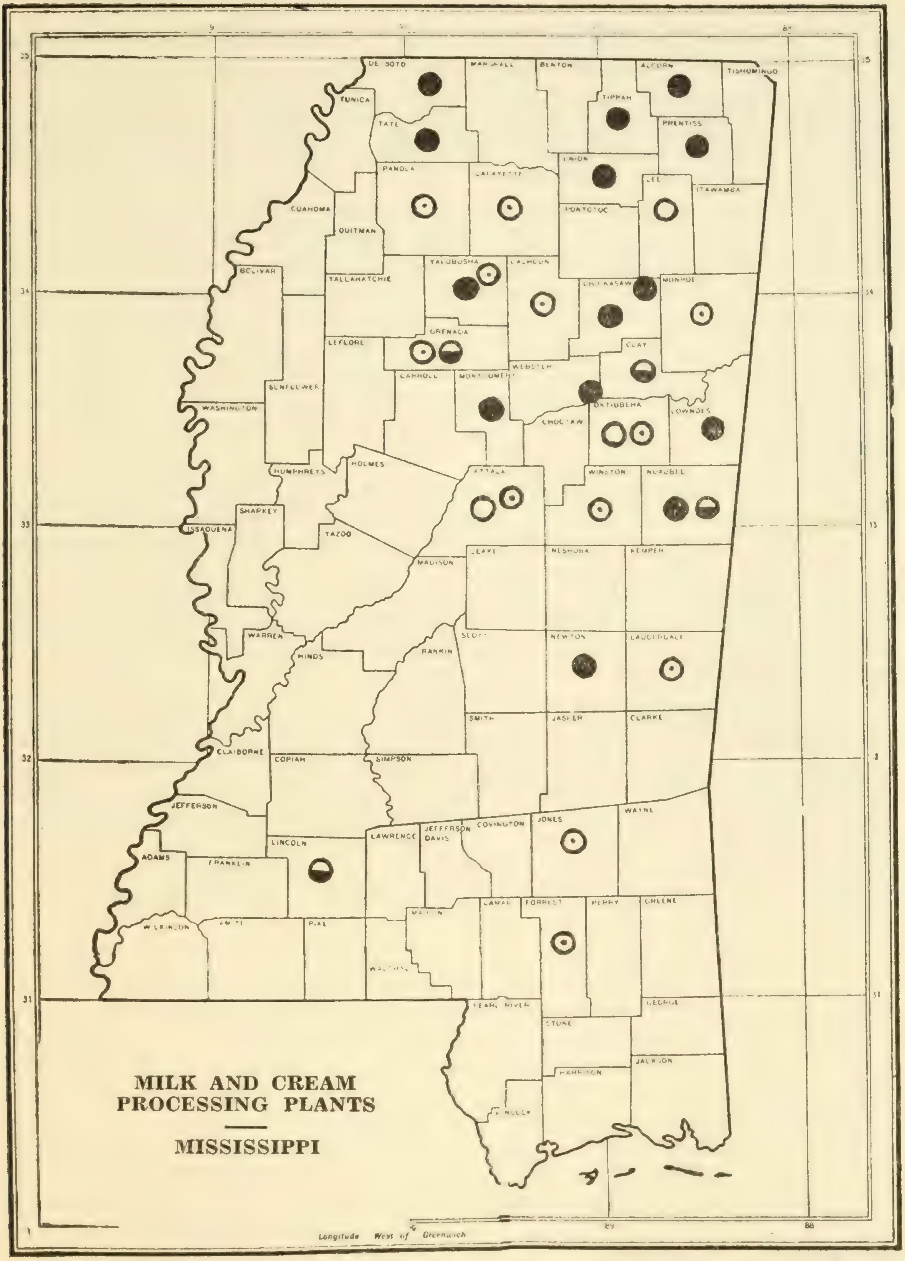

Figure 17. Distribution of cheese plants, creameries, condenseries, and combination plants in Mississippi in 1942.

⊙ Creameries

○ Condenseries

● Cheese plants

◒ Combination

Source: Dairy and Creamery Laws and Report of Dairy Industry, Department of Agriculture and Commerce, Jackson, Mississippi, 1942.

Index of Manufacturers, Mississippi Board of Development, Jackson, Mississippi.

sold. Likewise, the cheese plants and condenseries are in the areas where the whole milk sales are concentrated.

The combination plants make butter and cheese, or butter and condensed or evaporated milk. Some of the creameries are quite small and make only a little butter each year. This is particularly true of those in Grenada and Jones Counties.

The actual process of marketing the milk sold to the processing plants has been described in a recent bulletin published by this Station.[1] For the most part, the milk and cream are picked up at or near the farms at regular intervals by truckers who are independent operators. The producers pay the truckers a set fee, usually 25 cents per hundredweight for milk and 2 cents per pound for cream, for the hauling service. The milk plants collect the hauling fees by withholding the necessary amount from the producers' checks which are given twice each month. The truckers collect from the milk plants. The producers usually furnish their own milk cans.

Milk deliveries are made twice each day during the hot months from April through September and once each day for the remainder of the year. Milk that is to be used in the manufacture of cheese, evaporated or condensed milk, or sweet cream butter has to be delivered to the plants fresh and in good clean condition. Very few farmers have milk cooling facilities, so it is necessary that regular and frequent deliveries be made in order to insure a constant and satisfactory supply of milk to the processing plants.

A large proportion of the creameries in the State make only sour cream butter, and consequently their deliveries are not as regular as the other plants. Some of the larger creameries pick up the sour cream from collection and buying stations at regular intervals, usually once or twice per week. These stations are often operated independently by persons who buy the cream from the producer and resell it to the creamery offering the best price. Other stations buy cream especially for certain creameries, while still other buying stations are operated by the creameries themselves.

It was shown previously (figure 16) that a large amount of cream is produced in certain of the Clay Hill counties. A large proportion of this is sour cream which is produced by farmers who are not located on milk routes. They have some surplus milk during the spring and summer months. The usual practice is to separate the cream or skim it off after it rises and sell it to the cream buying stations. Some of the cream is hauled to creameries as much as 200 miles away from where it is produced. About 75 to 80 percent of the butter produced in Mississippi is made from sour cream. The Cooperative Creamery at Starkville makes only sweet cream butter and there is another creamery or two that make a little butter from sweet cream. All the others use nothing but sour cream.

The production of milk for fluid consumption is limited to areas around the towns and cities in the State and the areas that serve the fluid milk markets in Memphis and New Orleans. In the northern part of the State, especially in DeSoto and Tate Counties, there is a large group of dairies that produce milk for the Memphis market. Many of these dairymen belong to the Mid-South Dairy Association. The association sells the milk to retail dairy products distributors in Memphis. These dairies are all under the sanitary supervision of the health authorities of the city of Memphis.

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[1] Mebus, W. C., "Problems in the Transportation of Milk from Farms to Milk Plants." Agricultural Exeriment Station Bulletin No. 382, June, 1943.

In the southern part of the State, especially in Amite, Pike, Walthall and Pearl River Counties, there is another group of dairies that serve the New Orleans milk market. The milk is picked up at the farms by truckers who deliver it to cooling stations. From the cooling stations it is hauled in tank trucks to points in Louisiana where it is bottled and prepared for the New Orleans trade. The New Orleans health authorities supervise the sanitary conditions on the farms that produce milk for sale in that city.

Within the State, all the larger cities and towns have dairy products dealers who buy wholesale milk from the producers and retail it to the consumers. Almost all the smaller towns and some of the larger ones are supplied milk by some local dairymen who produce, bottle, and retail their own milk.

In all instances the orderly marketing of milk is dependent upon the efficient operation of milk trucks. Almost all the milk sold in Mississippi, whether processed or consumed fresh, is hauled from the farm to the buyer by truck. There are several hundred milk routes that are covered by trucks once or twice every day. The cost of operating these routes runs into a considerable sum of money, but it is an essential service. If one assumes an average price of 25 cents per hundred pounds for the nearly 387 million pounds of milk delivered to processing plants in 1942, the total amount paid by milk producers would be nearly a million dollars for the hauling service. The charge of 25 cents is not far from correct. In the study referred to above, it was found that the average cost for the routes included in the study was 23 cents per hundredweight. The costs are probably a little higher for the State, because many of the routes not included in the study operate in sparsely populated areas.

A systematic study of the transportation of milk, area by area, with the view of eliminating the problem of duplicating routes and increasing the volume hauled by each route, would no doubt result in a considerable reduction in the cost of milk hauling. Many studies of this type have been made in other areas with very good results. In Wisconsin, for example, an estimated 40,000 fewer truck miles are being traveled each day as a result of systematic studies in each area and changes suggested to reduce truck travel. This is an equivalent of 15 million truck miles per year.[2] Several studies made in the New England states indicate that similar results have been experienced in those states.[3] The results of these studies naturally could not be applied to Mississippi conditions, but the principles developed and the procedures followed should furnish valuable guides in the conduct of any similar work to be done in this State.

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[2] "Economic Information for Wisconsin Farmers," College of Agriculture, Madison, Wisconsin, April, 1943, p. 4.

[3] Hammerberg, D. O., "Wartime Problems of Conservation of Transportation", Journal of Farm Economics, Vol. XXV, February, 1943, p. 147.

As has already been pointed out, the manufacturing milk industry in the State is built around the processing plants. Before a plant can operate efficiently and profitably, it has to be assured of a sufficient volume of milk. Some types of plants require more milk than others for efficient operation. For instance, a condensery has to have more volume than a creamery or cheese plant, because of the differences in machinery and other equipment as well as in the processes necessary in the two operations. For this reason a cheese plant or a creamery might succeed in an area where a condensery would fail. The potential volume will usually determine the type of plant to be put in any area.

When the milk plants first started coming into Mississippi, they had to be established largely on the basis of the expected milk production. Some of them judged correctly; others did not. The successes and failures since that time tell the story. Almost all of the early plants had to operate for a time at a loss or on a "break even" basis, because enough milk to operate a successful plant of any kind just does not come overnight. On the other hand, a plant cannot afford to locate where there is no milk being produced. Rather, it goes where there is potential production and the outlet it furnishes causes an increase in production. Thus the plant and the dairy industry grow together and the success of each depends upon the satisfactory service it renders to the other.

The influence of volume on the successful operation of milk processing plants has been demonstrated in numerous studies in all parts of the country.[4] For the most part, the principles developed in these studies are general and have to be interpreted for local areas in the light of existing conditions. Analytical studies to show the relationship of volume to the successful operation of the various types of milk plants in Mississippi would be of considerable value to existing plants and would form a basis for extending plants into new areas.

Poultry and Poultry Products

It is estimated that about 45,500,000 dozen eggs were produced in Mississippi in 1942. Of the eggs produced, about 28,417,000 dozen were sold. The average farm price was 26 cents per dozen, and the total cash income from sales of eggs was $7,388,000.

In addition to eggs, the official estimates indicate that approximately 15,146,000 head of chickens, excluding commercial broilers, were raised in 1942. Of the chickens produced, about 8,288,000 were sold. The average weight was slightly over 3 pounds per bird and the average price was 18.8 cents per pound, so that the 25,178,000 pounds of poultry sold in 1942 brought the farmers a cash income of $4,733,000. The income from commercial broilers produced in 1942 was $746,000.

In other words, the estimated value of the chickens and eggs sold from farms in Mississippi during 1942 was about $12,867,000. These are official estimates furnished by the Bureau of Agricultural Economics. In

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[4] **Bressler, R. G., Jr.: "Economics of Scale in the Operation of County Milk Plants", New England Research Council and others, Boston, Massachusetts, 1942.**

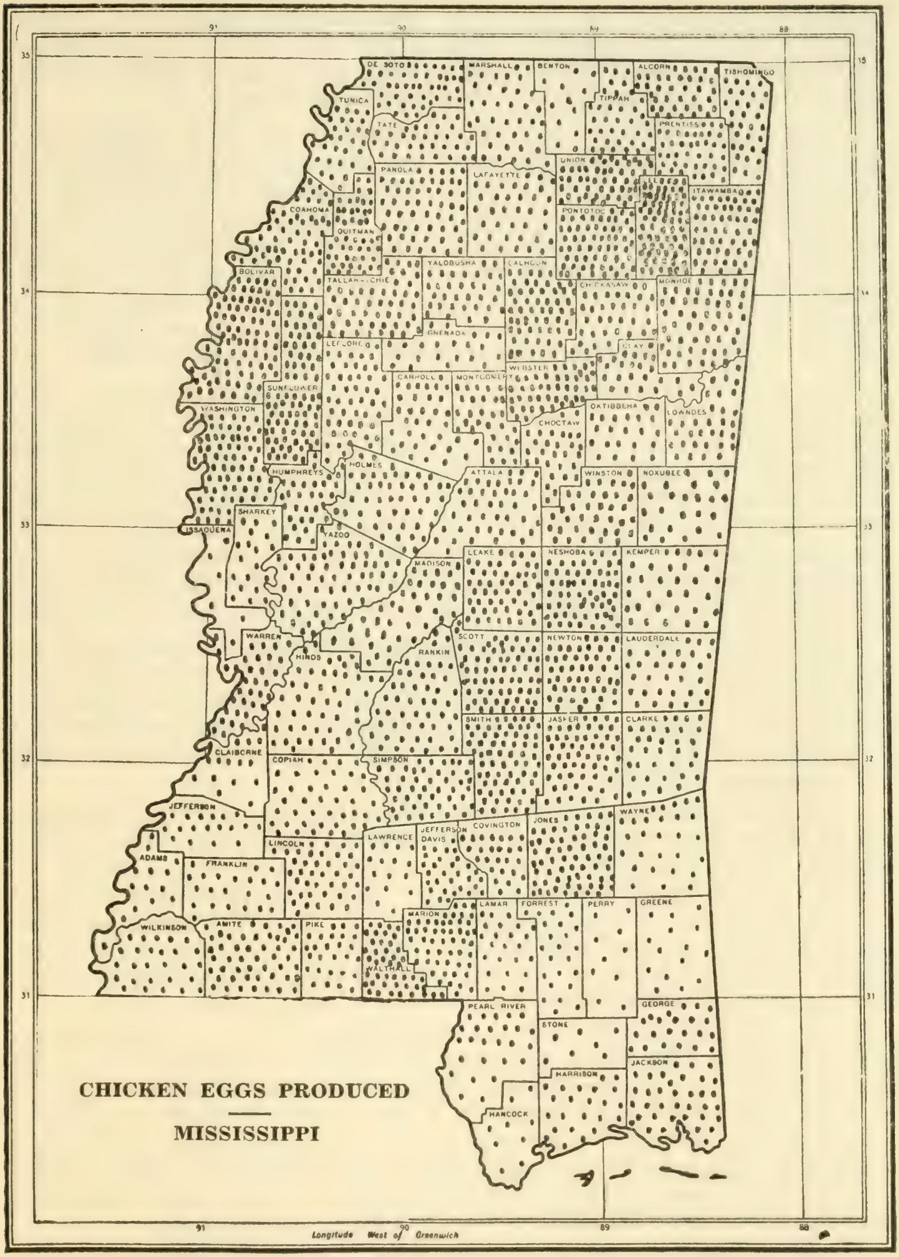

Figure 18. Distribution of chicken eggs produced in Mississippi, 1939.

1 dot = 10,000 dozen

Source: Census of Agriculture, Bureau of Census, 1940.

addition to chickens and eggs it is estimated that there were 143,000 turkeys raised in Mississippi in 1942. The total value of all the turkeys produced was around $400,000, based on an average weight of 12.5 pounds and an average price of 22.5 cents per pound.

Eggs are produced generally throughout the State. There is a tendency, however, for chickens to be concentrated more heavily in some areas than others (figure 18). There is a tendency, for example, for egg production to be heavier in Lee and surrounding counties than in the other counties around this area. Eggs are also produced in rather large quantities in a group of counties in the south central part of the State. Scott and Newton Counties from the center of this area. In addition, there are considerable quantities of eggs produced in some of the Delta counties, especially Washington, Sunflower, and Bolivar.

The total number of eggs produced, however, does not give a very good indication of the commercial importance of the poultry industry in any area of the State. The eggs sold would be a better measure of the commercial importance of the industry, but unfortunately the 1942 census did not include a tabulation of this item. Certain areas sell a much higher proportion of the eggs produced than others; the more thickly settled counties naturally consume more eggs than the sparsely settled areas. Therefore, it is possible to get from the total egg production only a rough indication of the commercial importance of egg production in the State.

In the case of chickens, the census gives a county tabulation of the number sold from farms in 1939 (figure 19), which shows that more chickens are sold in Rankin, Scott, Smith, and some nearby counties than in any other counties in the State. There are, however, concentrations in the Northeast Prairie and surrounding counties, as well as in some of the counties in the southern end of the State.

The actual buying and selling of chickens and eggs in Mississippi has for years been centered largely around the local store. Except for a relatvely small number of commercial producers, the majority of chickens and eggs are produced in farm flocks kept mainly as a source of meat and eggs for home consumption. In spite of inadequate care, the chickens in the farm flocks produce a surplus of eggs during February, March, April, and May, or until the weather gets hot. During the summer, fall, and winter months the production of eggs is quite low.

For a long time many farmers have followed the custom of trading their eggs at the local stores for groceries and other supplies. During the periods of low egg production the local store keeper sells these eggs to his other customers, or perhaps to a trucker who sells them to stores in a nearby city. During the months of low production, there is a deficit of eggs in Mississippi. Naturally there are surpluses in some of the better poultry areas and on some farms throughout the State, but all the eggs can be handled by shifting them to nearby deficit areas.

Perhaps the most serious problem faced during the summer months is the low quality of the eggs when they reach the market. Many farmers come to town only once per week and consequently the eggs are brought to market mostly on Saturday. Some of the eggs are a week old when they reach the local store. Not many of the stores have cold

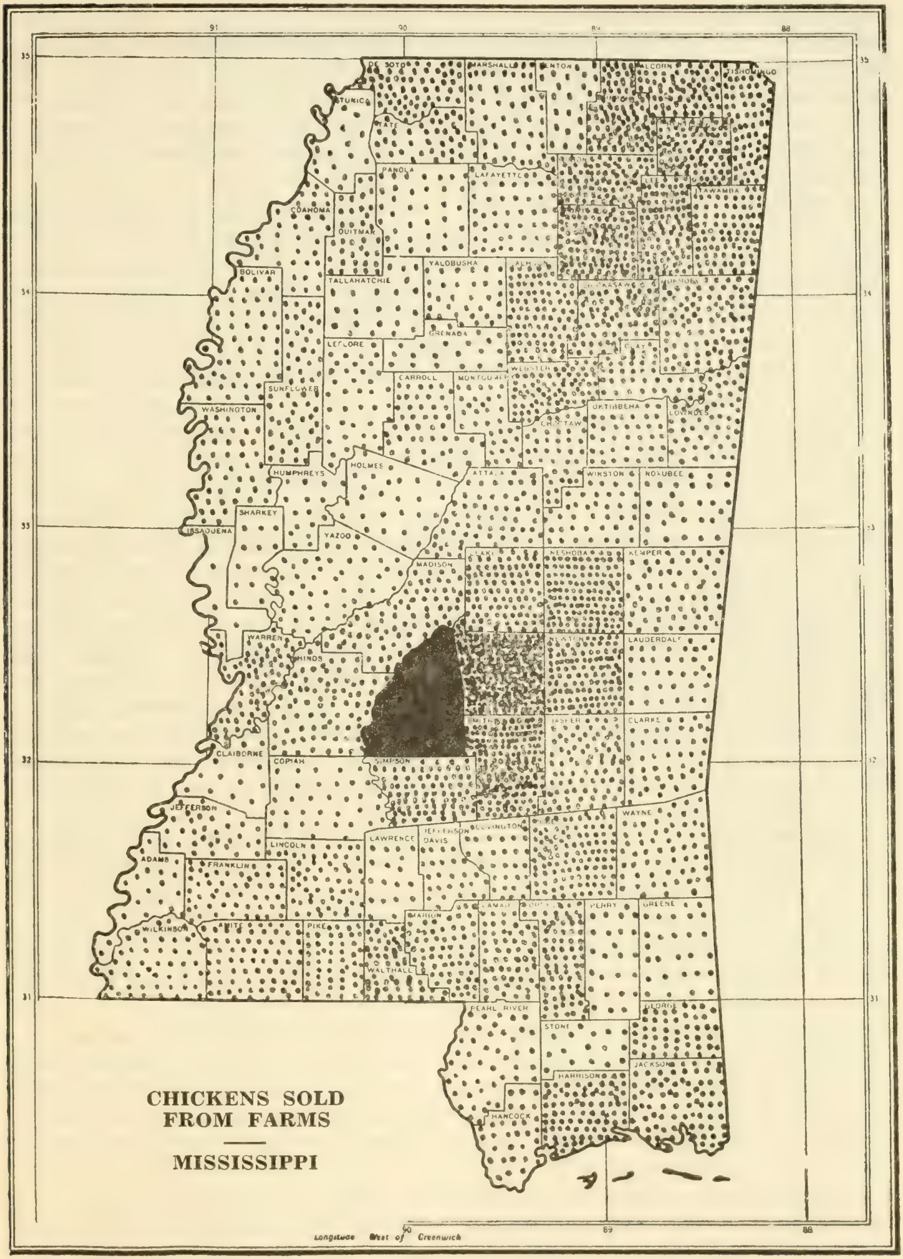

Figure 19. Chickens sold from farms in Mississippi, 1939.

1 dot = 500 head

Source: Census of Agriculture, Bureau of the Census, 1940.

storage facilities to handle eggs, and as a result the eggs often reach the consumer two or three weeks after they are laid or go into cold storage in central markets for later consumption. During this period they will have been hauled considerable distances and at the same time will have been subjected to the normal summer temperatures. It requires little imagination to picture the condition of many of these eggs when they finally reach the consumer.

The problems involved in handling eggs during the slack hot months are quite clear; the solution of these problems is not so easy to arrive at. In the first place the farmers who have farm flocks are almost always small producers with not enough volume to justify the expenditure of much time and money in providing the facilities and taking the precautions necessary to assure the delivery of good quality eggs to the local stores. Another point is the fact that when all the eggs are assembled in the local trading center there is usually not enough volume to support an efficient marketing system throughout the year. Consequently, such a system as has been developed has been in connection with local stores that have the handling of eggs as only a part of their business.

There has developed a group of egg and poultry dealers that usually serve a territory of several towns or communities. These dealers usually have a centrally located place of business where they buy direct from the local producers, but, in addition, they make regular trips into the surrounding territory and buy eggs and poultry from the local stores. They thus serve as an outlet for the surplus accumulated by these local merchants. A problem often encountered by many of the local store operators, especially those located in small out-of-the-way places, is that they do not have enough volume during the low production season to pay the dealers to continue the truck service to collect their eggs. Therefore, during part of the year the store keepers have no market outlet for the eggs they buy, and for many that do have a market, pick-ups are made only once in 2 weeks. As long as the volume is not enough to support more adequate handling facilities the quality will be poor, and at certain seasons the prices will fall to ruinously low levels.

Normally the egg and poultry dealers have found their best outlets in the markets of Memphis and New Orleans. At the time when Mississippi has its greatest surplus of eggs there is a surplus in almost all other areas. During such times the surplus eggs usually move to the egg drying plants or into the hands of wholesalers who store them until the supply is not so great. The fact that the volume of eggs has not been sufficient in many areas in Mississippi to support a marketing system that will move the eggs into these regular channels, results in an accumulation of eggs in these areas during the short surplus period and consequently, often causes a very low price.

Almost none of the dealers make any attempt to buy or sell eggs on a graded basis. The usual transaction is made on what is known as a "current receipt" basis. "Current receipt" eggs are yard run eggs that have not been graded. In other words, they are average eggs with all sizes and qualities included. Some dealers pay a small premium, usually one to two cents per dozen, for white infertile eggs. The system of marketing in many local egg markets is such that it is very difficult to do any type of grading. For example, a very large proportion of the eggs that are sold at Eupora in Webster County are brought in on Saturday. One firm employs from six to eight persons on Saturdays during the peak season to do nothing but count eggs and transfer them from the farmers' baskets and buckets to egg crates. Only a few farmers have as many as a crate of eggs per week. It will be quite difficult to work out a scheme to grade all of these eggs on Saturday so that the farmers get paid on a graded basis. As a rule, the dealers do not have cold storage space and they are anxious to move the eggs as quickly as possible in order to avoid any further lowering of the quality. Consequently, the eggs are often loaded out to markets in Memphis on Saturday night or Sunday morning; otherwise they remain in the store building over the week end. Somewhat the same situation is repeated many times in local egg markets throughout the State.

A rather interesting system of handling eggs and poultry has been developed in Scott, Rankin, and parts of the surrounding counties. A group of feed dealers started several years ago to develop the poultry industry in that section of the State. They organized regular routes through the country and began selling and delivering feed, poultry supplies and equipment, and young chicks to the farmers along these routes. In addition to making these deliveries the route operators picked up the eggs and chickens that were for sale. They developed outlets for these products and by making regular collections at the farms have been able to put a good average product on the market. Many of these operations are financed by the dealers; that is, they buy and place among farmers baby chicks, together with the supplies and equipment necessary to raise broilers. The dealers then collect and market the broilers and make a settlement with the producer. In the case of eggs and other poultry, the usual practice is to make a monthly settlement.

As shown previously (figures 18 and 19) the production of both eggs and chickens for sale is concentrated in this area. In addition to being both sellers and buyers the dealers serve in an advisory capacity to the poultry producers. It is probably true that the advice is flavored by the particular brand of feed handled, but in spite of this the continual growth of the industry over a period of years is evidence that the development has been mutually beneficial to both producer and dealer.

Cooperative marketing of poultry and eggs has not been attempted on any large scale until recently, although one cooperative poultry producers organization in the State has been operating since 1929. This organization, known as the "United Poultry Producers," is located at Ocean Springs, in Jackson County. There are at present about 125 members, most of whom are commercial poultry producers. The organization has been able to develop a very good demand for their "Gulf Coast" white infertile eggs. All eggs are carefully graded. All producers are expected to gather the eggs from the nests four times each day and to deliver them to the cooperative headquarters at least twice per week. The volume of eggs handled has increased from 2,554 cases in 1930 to 8,257 cases in 1943. In addition to eggs and poultry the cooperative handles feed and poultry supplies.

During the past 4 years the Marketing and Poultry Divisions of the Mississippi Extension Service have been working with certain branches of the Mississippi Federated Cooperatives in the establishment of a cooperative marketing system for eggs. The main headquarters for the organizations that are operating at present are at Hattiesburg, Grenada, and Booneville. The branch at Booneville started operating this year, while the Grenada branch has been operating 3 years, and the one at Hattiesburg about 3 years. The territory around each of these main locations is served by truck route operators that make regular egg collections at assembly points along the routes. The location of the main headquarters of the counties they serve, and the location of some of the main poultry and egg dealers in the State are shown in figure 20.

The eggs that are assembled at points along the routes are packed in cases by the operators of the collecting stations. Each cooperator's eggs are kept separated so that returns can be made to each producer on a graded basis. If a producer has less than a case, the ticket bearing the number of dozen and the producer's name is placed in the case between the layers that separate his eggs from another producer's. The persons operating the collecting stations are usually paid a small fee for performing this service. The majority of the eggs are graded at the main headquarters, and usually in about a week each producer is given a statement showing the quantity of eggs he had in each grade together with the price of each grade.

Since the beginning of the war almost all the eggs collected at Hattiesburg and Grenada have been going to army camps. Before the war the cooperatives were having some difficulty in establishing satisfactory outlets that would pay a sufficient premium to take care of the costs of grading. The temporary demand furnished by the army camps helped solve that problem for the present. It is likely, however, that the same problem will return with considerable force at the close of the present conflict. It is very important that a lot of thinking and studying be done now to try to help improve our present poultry and egg marketing system. The logical point at which to begin such planning would be a detailed and objective analysis of all phases of our present system with the view of revealing its major faults and developing a sound program of improvement.

A few turkeys are produced on some farms in almost all the counties in the State, but turkeys are of commercial importance in only a few counties. In most areas turkeys are handled by the regular poultry dealers. However, the Marketing and Poultry Divisions of the Mississippi Extension Service have been conducting special turkey sales in four counties at which considerable numbers of turkeys are sold. A Thanksgiving and Christmas turkey pool is conducted each year. All the turkeys are sold on a graded basis. At the two sales in 1942 a total of 155,426 pounds were sold for $40,949. Almost two-thirds of the turkeys sold were from Noxubee County. The others came mainly from Oktibbeha and Lowndes Counties with a few from Kemper County.

Sheep, Lambs, and Wool

The distribution of sheep and lambs sold from farms in Mississippi in

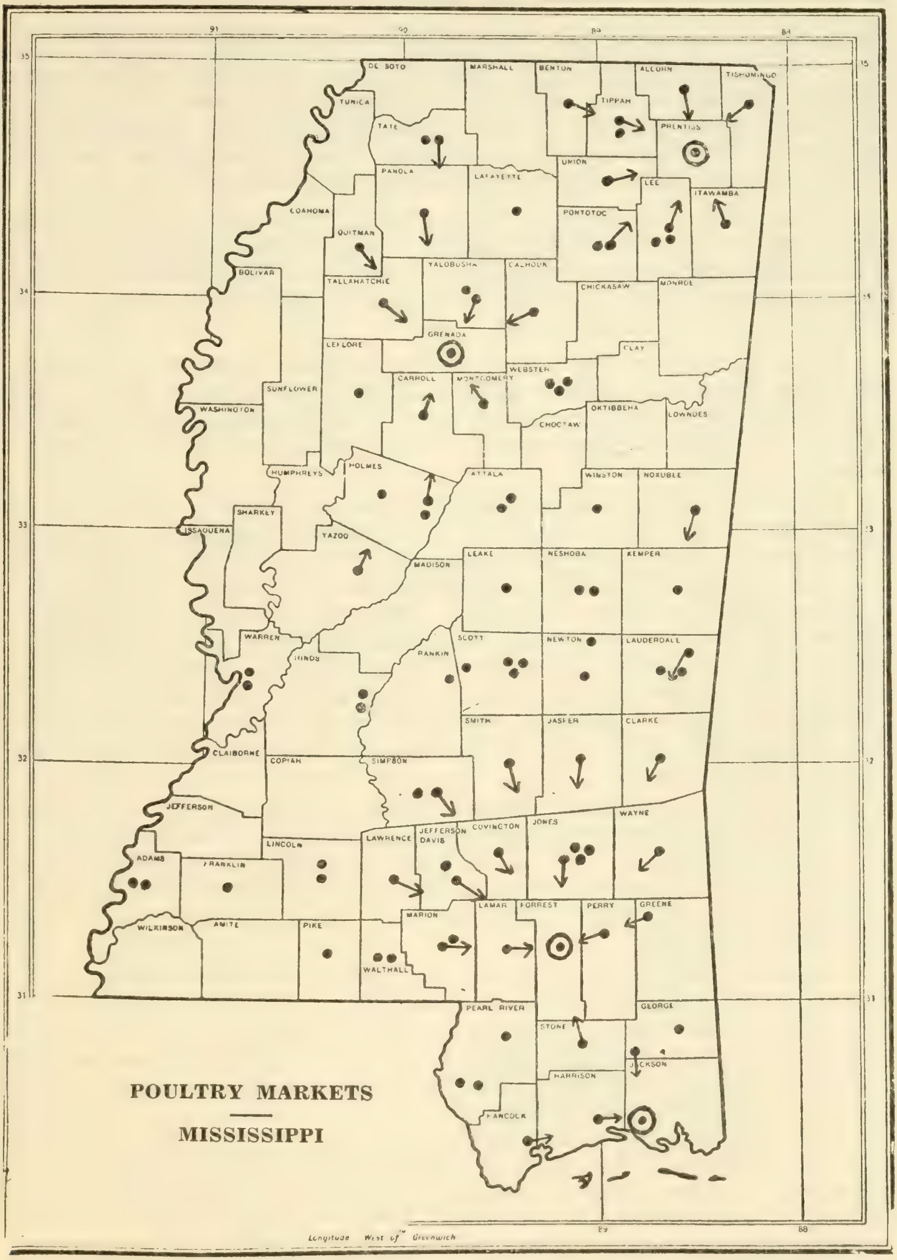

Figure 20. Distribution of the cooperative egg and poultry marketing organizations and some of the main poultry and egg dealers in Mississippi, 1942.

⊙ Cooperative headquarters

●→ Areas served by cooperatives

● Poultry and egg dealers

1939 is shown in figure 21. The greatest concentration is in the Lower Coastal Plain and Gulf Coastal Counties. In this area sheep are kept under range conditions and are maintained largely for their wool. Such sheep and lambs as are sold are usually taken direct from the range and sold "gate run." Because of their hardy nature many ewes from this area are sold to producers farther north for foundation herd stock.

In the other areas many of the lambs and sheep are sold at special lamb sales sponsored by the Marketing and Animal Husbandry Divisions of the Mississippi Extension Service. In 1942, four lamb pools and sales were conducted at Macon, Starkville, and Jackson, and a total of 853 lambs were sold at the four sales.

In the summer of 1943 six lamb sales were conducted at Macon, Starkville, Jackson, Natchez, and Greenwood. A total of 2,491 sheep and lambs were sold at an average price of $9.89 per hundred pounds or a total of $17,640. All the lambs at these sales were sold on a graded basis.

Because of the fact that there has not been a large volume of lambs in any area, it has been difficult to get any great amount of competition in any lamb markets or at the special sales. The only large slaughterer of lambs anywhere within reasonable distance of Mississippi producers is located at Montgomery, Alabama. This firm bought all the lambs at each sale in 1943. Market prices were paid for the grades of lambs sold, but the sale was largely a matter of assembling the lambs and taking what the one bidder offered. This is not given as a criticism but merely a statement of fact. There is no regular market for sheep or lambs in the State except that which is provided by the auction markets and the special lamb pool sales.

There are so few lambs offered at the regular auction markets that there is no ready demand for those that are offered. The assembling of fairly large numbers of lambs in one place, as is done in the special sales, so that even one large buyer can afford to bid, no doubt results in the producers getting a higher price than they would get by following any other method of sale.

The wool that is produced in South Mississippi is handled by the South Mississippi Wool Growers Association. This is a cooperative organization of wool producers that has been operating since 1912. Each county in the main wool-producing area has a local organization with a board of directors, and representatives of these local organizations form a board of directors for the larger association. Usually the county agent serves as the secretary of the local organization. In the spring of each year the producers report to the county agent about the quantity of wool he expects to shear. These estimates are brought together and a notice sent out to wool buyers all over the country that a sale will be held on a certain date of about so much wool. On the specified date the board of directors of the association meets and considers the offers. Full authority for accepting a bid is vested in this board.

In 1942 the association sold six cars or about 300,000 pounds of wool. Usually the wool is divided into about four groups, as: clear grease wool, light burry, medium burry, and hard burry.

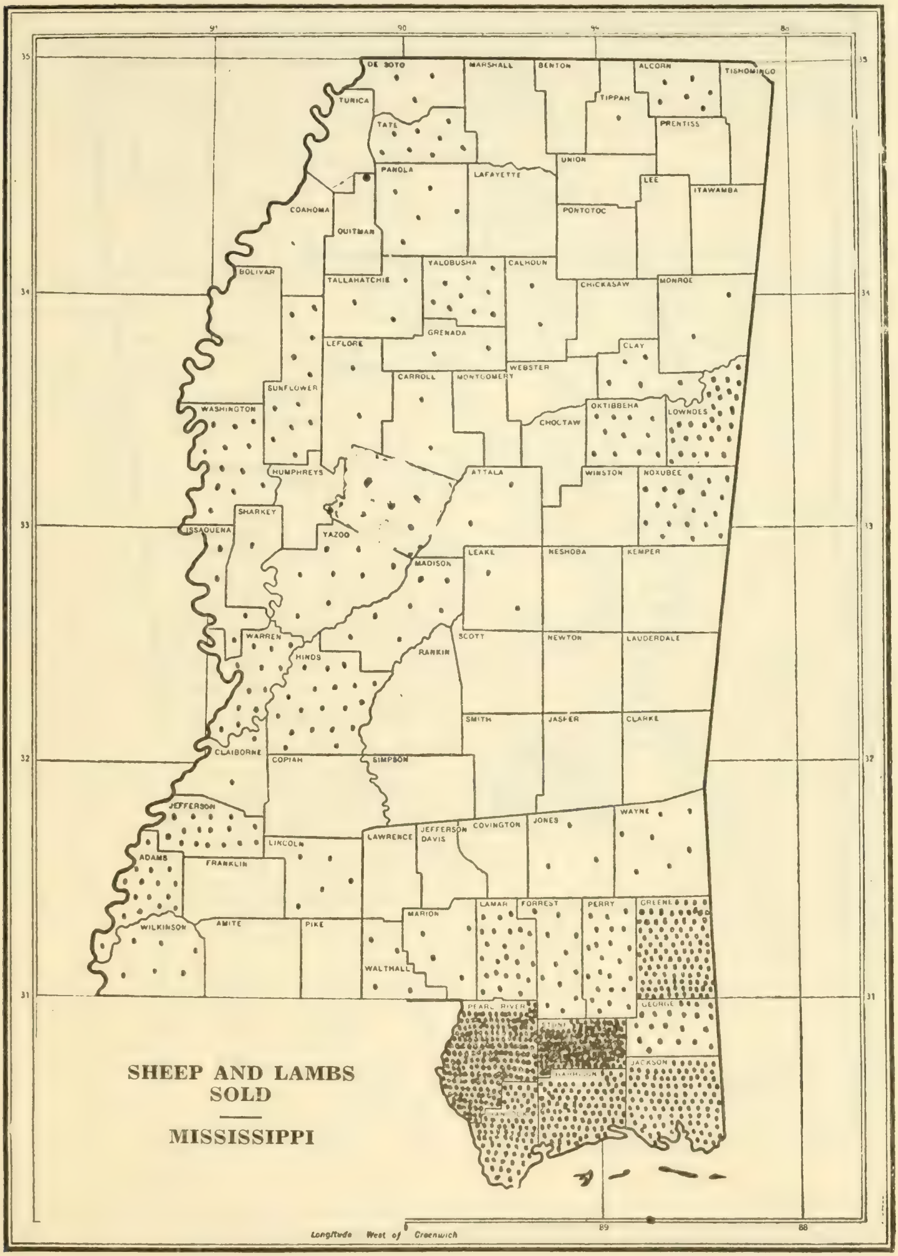

Figure 21. Distribution of sheep and lambs sold in Mississippi, 1939.

1 dot = 25 head

Source: Census of Agriculture, Bureau of the Census, 1940.

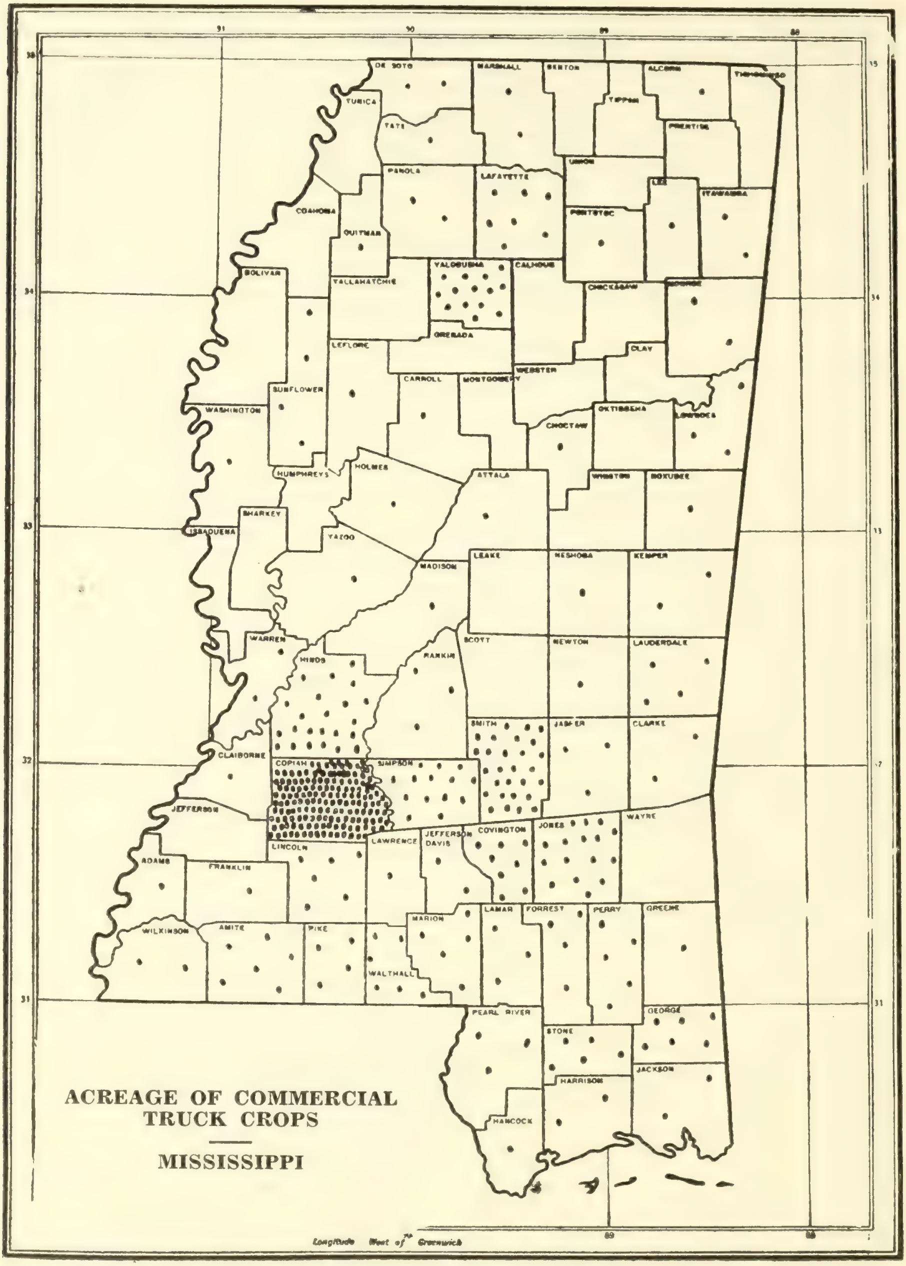

Figure 22. Distribution of vegetables (exluding Irish and sweetpotatoes) harvested for sale in Mississippi, 1939.

1 dot = 100 acres

Source: Census of Agriculture, Bureau of the Census, 1940.

In other areas of the State, the wool is handled in special wool pools that are conducted similar to the lamb pools. In 1942, three pools were conducted at which a total of 29,300 pounds of wool were sold for $12,900 or an average of $.44 per pound. In 1943 seven pools were conducted. The volume increased to 57,555 pounds and the total sale value to $26,475. The average price was $.46 per pound.

TRUCK CROPS

During 1939 there were 38,634 acres of vegetables harvested for sale in Mississippi. Irish and sweetpotatoes are not included in this figure. The vegetables harvested for sale had a value of about $1,700,000. By far the greatest portion of this income was from tomatoes, cabbage, watermelons, string beans, and green peas. The distribution of the acreage of vegetables harvested for sale in 1939 is shown in figure 22.

A glance at this figure shows that almost all the commercial vegetables are planted in the southern one-third of the State. A majority of the commercial tomatoes, green peas, and a large proportion of the cabbage and snap beans are produced in Copiah County. However, some string beans and cabbages are produced in several counties in the southern portion of the State. Considerable quantities of beans, spinach, turnips, and other greens are produced for canning purposes in Jones, Marion, and Walthall Counties. Watermelon production is concentrated in Yalobusha, Smith, and Simpson Counties.

Sweetpotatoes are grown rather generally throughout the State. In the past, however, a large proportion of the farmers have planted only small patches of sweetpotatoes and have used them mainly for home consumption. This is particularly true for the northern half of the State. The distribution of the acreage of sweetpotatoes planted in Mississippi in 1939 is shown in figure 23. This figure includes both potatoes for home consumption and for commercial purposes; consequently, it gives only a very rough indication of the commercial importance of the sweetpotato crop. It will be noted that sweetpotato production is more heavily concentrated in the southern part of the State in what is known as the Longleaf Pine Area. More sweetpotatoes are produced for sale in these counties than in any other portion of the State; however, small quantities of potatoes are sold from some farms in almost all counties in Mississippi.

Small quantities of Irish potatoes are produced in almost every county in the State. In all except a few counties, however, these potatoes are consumed in the home. The only area in the State where Irish potatoes are produced in sufficient quantities to be of commercial importance is in Marion, Walthall, and small sections of surrounding counties. The distribution of the acres of Irish potatoes planted in Mississippi in 1939 is shown in figure 24.

As would be expected, the main vegetable markets in Mississippi are located in the areas where the crops are produced. In the Copiah County area the main markets are at Crystal Springs and Hazlehurst. At each of these places a certain section in the town has been designated as the market place. For example, at Crystal Springs a paved place between a railroad platform and the main street of the city is the meeting place of the farmer and the buyer. This place has been lined off so that the

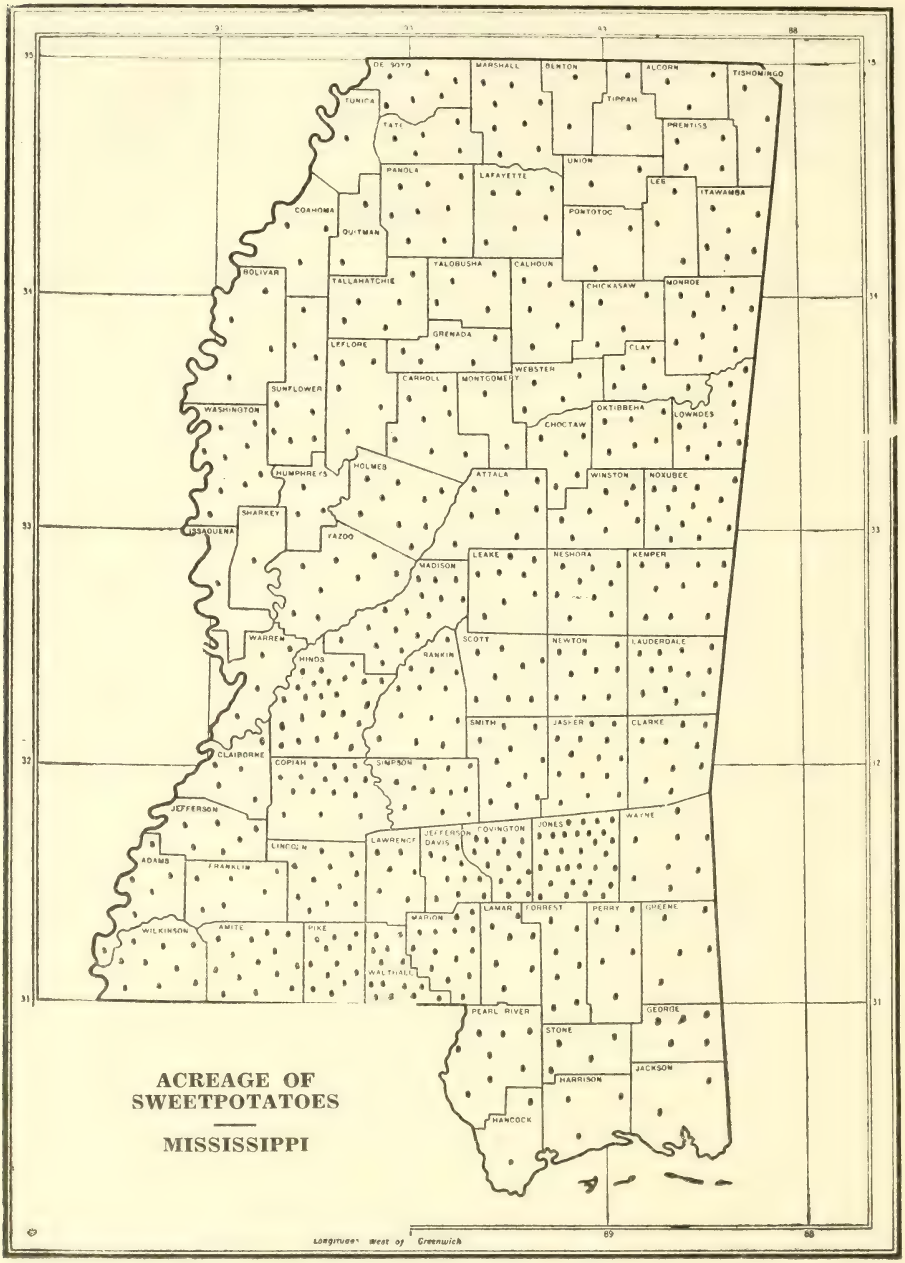

Figure 23. Distribution of acres of sweetpotatoes planted in Mississippi, 1939.

1 dot = 100 acres

Source: Census of Agriculture, Bureau of the Census, 1940.

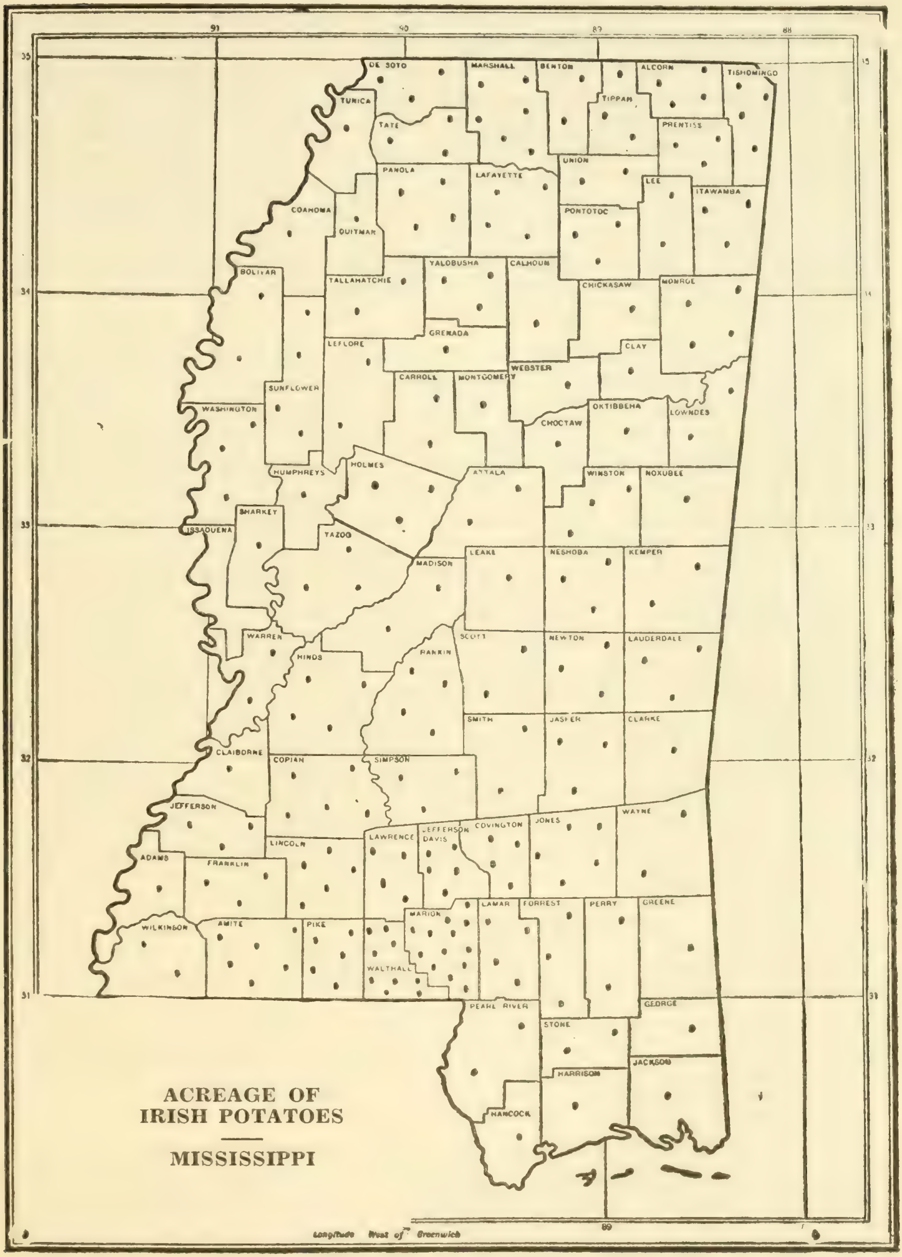

Figure 24. Distribution of acres of Irish potatoes planted in Mississippi, 1939.

1 dot = 100 acres

Source: Census of Agriculture, Bureau of the Census, 1940.

farmers drive in at one end of the market place and form several lines. As the farmers drive in, the buyers examine their loads of produce and one of them will place a beginning bid. Other buyers may raise this bid immediately. The farmers may take the highest bid at this time or may remain on the yard and contact other buyers to see if they can get a higher price. Thus, the farmers themselves act as auctioneers in arriving at a satisfactory sale for their produce. As sales are made the farmers pull out of line and proceed to the buyers' packing shed and unload their produce. The buyers at the yard give the farmers a ticket which indicates the price as well as the quantity of produce in the load. After each load is checked in at the packing house, the farmer is given a check for the amount due him.

This so-called market place or "hot spot" at both Crystal Springs and Hazlehurst is little more than a wide space in the road. There is no shelter at either place. It was observed at Crystal Springs that police officers kept the produce coming in and moving out in an orderly fashion. However, even with regular police supervision at times farmers would be lined up for a block or two away from the market place waiting to get to the proper point to sell their produce. Usually there was another period of considerable waiting in line at the packing shed. All this time the produce was being subjected to the hot sun and at times the rain.

At Hazlehurst no police supervision was provided, consequently during the rush periods the entire intersection of one main street was blocked. There was no particular order in which the vehicles came into the market place. They often came in from several directions and it was observed frequently that after a farmer had made a sale he had considerable difficulty getting out of the jam so that he could proceed to the packing house. It was observed in several cases that a farmer could get only one buyer to place a bid on his load. This was particularly true where there was a large number of loads in the market at the same time and the particular farmer in question had to park on the outside of the group.

On each of these markets there were usually from 10 to 15 buyers at all times during the day. Several of the buyers were local business men who make their permanent residence in the area. Others were itinerant buyers who follow the vegetable crops from area to area and as soon as the season is over in one place they move on to another. Some were specialized buyers who deal in only one crop; others bought several crops. There were usually from one to several buyers for each product brought to the market.

The main products sold on these two markets are cabbage, tomatoes, string beans, and green peas. These products are all bought on a field run basis. That is, the farmers usually bring them in as they pick them. The bids are made on the basis of the buyer's estimate of the value of the products. In the case of tomatoes, they are all brought to the local market in standard tomato field boxes. These boxes hold about a bushel of tomatoes and the farmer is paid so much per field box. At the packing shed the tomatoes are poured from the field boxes onto the conveyer belt of the cleaning and grading machinery. The field boxes are owned by the growers and after being emptied are returned to them.

Tomatoes in the Copiah area are picked green and are wrapped and packed in lugs for shipment. In the packing process the tomatoes are usually brushed and waxed. They are sized by machines and wrapped and packed in the lugs by hand. The most common pack used in the Copiah area is what is known as the "bulged pack." The most common size of tomatoes packed for shipping is the 6x6 lug. There are, however, considerable quantities of the 6x7 size packed and shipped.

A large portion of the tomatoes shipped from Mississippi are sent out in carload lots. The packing sheds are usually located adjacent to railroad tracks and the packed lugs of tomatoes are loaded directly into the cars. After the tomatoes are loaded into the cars the buyers follow the practice of selling in carload lots to the regular produce trade in out-of-state markets. The local buyers follow the practice of selling all the tomatoes they can on an f. o. b. shipping point basis. In cases where satisfactory sales cannot be made on this basis, the loaded cars are rolled and an attempt is made to make a sale while the tomatoes are in transit. If a sale is made, the car is diverted to the buyer. If the local shipper should not succeed in selling the rolling car it is usually diverted to a broker or to an auction market.

The tomatoes produced in Mississippi in the spring season of 1943 were shipped to 31 states and the District of Columbia. The approximate number of carloads of tomatoes and cabbages going into the various states for the past three seasons is shown in table 19.

The largest receivers of Mississippi tomatoes were Pennsylvania, New York, Illinois, Virginia, North Carolina, and Massachusetts. Each of these states received more than 50 carloads during the 1943 season. Pennsylvania was the largest receiver with 150 carloads.

For the most part, Mississippi cabbages are handled by the same dealers that handle tomatoes. For shipment in carload lots, cabbages are usually packaged in 50-pound sacks. During the 1943 season, the cabbages produced in Mississippi were shipped into 30 different states and the District of Columbia. The largest single receiver of cabbage was Illinois. Other states that received over 50 carloads were Michigan, Missouri, New York, Ohio, and Pennsylvania.

The straight carlot shipments of green peas, cabbage, snap beans, and tomatoes for the past 17 years are shown in table 20. It will be noted that the carlot shipments of green peas were considerably lower during the past 5-year period than they had been during any other similar period since 1927. The shipments of cabbages and snap beans have varied from season to season during this period but there has been no definite tendency for the carlot shipments to increase or decrease. In the case of tomatoes, however, the average carlot shipments during the 4-year period from 1940 to 1943 were only about 1/4 as large as they were during the 4-year period from 1927 to 1930.

During the 1927 shipping season there were 4,849 carloads of tomatoes shipped from Mississippi but by 1943 the shipments had been reduced to 909 carloads. There has been a tendency during the past several years for the carlot shipments of tomatoes to decline in the Copiah area. The increased movement of tomatoes by truck may be

Table 19—Approximate distribution of Mississippi tomatoes and cabbage based on original billings and diversions, 1941, 1942, and 1943

Destination State	Tomatoes			Cabbage		
	1941	1942*	1943*	1941	1942	1943
Alabama	9	10	6	1	......	1
Arkansas	......	1	1	......	2	2
California	......	......	......	4	......	......
Colorado	7	2	1	10	11	6
Connecticut	3	3	......	17	16	14
District of Columbia	24	31	22	26	6	2
Georgia	20	5	12	......	1	......
Illinois	43	84	52	303	365	129
Indiana	15	27	21	96	79	27
Iowa	18	25	16	38	34	38
Kansas	2	9	......	5	10	2
Kentucky	26	63	28	9	29	21
Louisiana	1	3	2	......	15	6
Maine	5	1	6	6	6	6
Maryland	22	25	47	1	8	9
Massachusetts	56	24	51	66	81	22
Michigan	16	33	26	88	118	64
Minnesota	12	9	5	45	56	29
Missouri	4	18	13	13	43	51
Nebraska	2	5	......	9	12	7
New Jersey	......	......	4	......	5	......
New York	69	75	99	112	110	66
North Dakota	1	2	1	2	2	1
North Carolina	62	32	61	1	1	......
Ohio	43	75	39	140	171	65
Oklahoma	......	2	3	4	5	7
Pennsylvania	104	132	150	143	219	81
Rhode Island	14	7	3	6	6	11
South Carolina	11	2	11	2	1	......
South Dakota	......	3	......	1	3	1
Tennessee	34	62	56	4	8	25
Texas	......	......	1	1	3	19
Vermont	1	4	2	1	3	1
Virginia	102	89	86	......	8	1
Washington	......	1	3	......	......	......
West Virginia	15	45	24	14	24	28
Wisconsin	7	13	8	14	21	10
Wyoming	......	......	......	4	2	......
Total	748	922	860	1,186	1,452	752

Source: **Review of 1943 Marketing Season, Mississippi Vegetables and Tomatoes,** Ralph G. Risser, W. F. A.

*Through June 22.

sufficient to partially offset this decline. After taking this factor into account, however, the decline in tomato shipments is still striking. As a result of efforts to find the causes for this decline several factors were found that might help in solving this particular problem. The farmers of this area are almost unanimously agreed that the tomatoes should be packed on the farms. They blame the rough treatment given the tomatoes in running them through the packing sheds for the fact that Mississippi

Table 20—Straight car shipments Mississippi vegetables and tomatoes, 1927-1943

Season	Green Peas	Cabbage	Snap Beans	Tomatoes
1927	243	710	143	4,849
1928	250	1,249	192	3,230
1929	199	1,689	312	4,099
1930	234	931	310	3,451
1931	282	1,148	208	2,683
1932	46	718	284	2,869
1933	100	796	45	2,408
1934	166	1,991	418	3,012
1935	132	1,674	339	2,355
1936	266	2,159	438	2,331
1937	237	2,086	221	2,104
1938	173	2,496	195	2,863
1939	90	2,494	170	1,990
1940	20	1,517	54	937
1941	62	1,580	132	858
1942	96	1,957	153	1,217
1943	......	985*	115*	909*

*Through June 21 only.

tomatoes have not been able to successfully compete in northern markets with tomatoes from other areas.

It seems that before the packing sheds were built the farmers did all the picking and packing on their farms. The tomatoes were picked in the early pink stage and were packed in 2-quart baskets. The baskets were then packed in tomato crates with six baskets to a crate. During the summer of 1942 eighty farmers in the Copiah Truck Area were interviewed in connection with a survey of production and marketing problems. Sixty-three of the 80 farmers said that the grading and packing of tomatoes should be done on the farm. Only 13 farmers indicated that the packing should be done at the packing sheds as at present. The other four farmers did not know where it should be done. These farmers claimed that as long as tomatoes were packed in this fashion they had no difficulty in disposing of them at satisfactory prices. Furthermore, they are very definite in their statements that the green wrapped tomatoes that are being packed at the present packing sheds are the main cause of most of their troubles.

Another and perhaps more important factor in the decline of tomato shipments has been the increased competition from other areas, particularly Texas. The shipping season for the Mississippi tomatoes has been limited to from two to three weeks in the middle of June. During some years the season is even shorter. The prices of Texas tomatoes on the same markets are almost always higher than those for Mississippi tomatoes. During the 1943 season the prices of U. S. No. 1, 6x6 tomatoes averaged higher for Texas than for Mississippi tomatoes on every market for which official quotations are available. For example, the simple average price of Mississippi U. S. No. 1, 6x6 tomatoes on the Philadelphia market during the 1943 season was $3.67 per lug; whereas, on the same days Texas tomatoes designated as the same size and quality sold for an average of $4.34, or a difference of $.67 per lug. More Mississippi tomatoes go to Philadelphia than to any other market. The averages for the Chicago market were $3.37 for Mississippi and $3.82 for Texas, and for the New York market the averages were $3.88 for Mississippi and $4.00 for Texas. Other markets had similar differences. This same situation was true for the 1942 season.

Many explanations are given as to why this difference in prices has persisted. Among them are that the Mississippi tomatoes are often not mature, that they are bruised in packing, and that they are mashed in the process of putting the lid on the bulged pack. Whether or not these charges are true is not definitely known and probably will not be known to the satisfaction of all concerned until more factual information is available.

The farmers often blame the shippers, or the middlemen, for the low prices they receive. The common accusation is that the middlemen are taking a large profit and leaving the farmers with very little. The basis for such accusations is the fact that the farmers sell their produce to the local shippers and very often they have only a faint idea of the costs involved in carrying the produce through the packing house and shipping it to the central markets. The actual costs and margins involved in the handling and shipping process are not known. The prices to the growers are not quoted by the government reports. Due to the fact that the farmers sell their tomatoes in field boxes on an ungraded basis and the tomatoes are sold by the local buyers on a packed basis it is difficult to determine farm prices that are comparable with the dealers' prices. Until such information is available there is no basis for making any objective statements about the margins being taken by the local dealers. A research study designed to describe and provide the costs involved in each step of the marketing of tomatoes as well as the other main crops produced in the Copiah area should do much to furnish basic information upon which to base suggestions for solving the problems faced by this area. If after the war is over, the trends that were in operation for several years before the present war are resumed, it does not require much imagination to picture the situation in this area ten to fifteen years from now.

Several attempts have been made in the past to improve the marketing of vegetables and tomatoes in the Copiah area. For the most part these attempts have been designed to force adjustments by introducing a competing marketing organization in the form of a cooperative association. A few years ago the Copiah County Truck Growers Association was organized. As has been done in most cases the farmers were persuaded to become members of the organization by assuring them that by so doing they would be guaranteeing themselves a higher price for their produce. They were further assured that by cooperating in the formation of their own organization they could eliminate the middleman and many of the functions he performs.

With such a program the organization was launched with much gusto and lasted for only a few years. The management attempted to sell largely to chain stores and thus eliminate some of the costs involved in going through the regular channels of trade. It was soon discovered that the chain store buyers went to the areas where the produce was cheapest and that they bought much of their supplies in crowded markets. They did not furnish a steady and regular market for any one area or organization and therefore could not be counted on as a sole outlet. The cooperative organization soon found itself in difficulty and was unable to return to the growers a price equal to that being paid by the local dealers. Sponsors of the cooperative claim the dealers were willing to increase their prices in order to hasten the failure of the cooperative. However, the fact remains that the cooperative organization was not able to fulfill the glowing promises that had been made to the growers and they gradually withdrew their support.

The experience of this cooperative will probably make it very difficult for a similar organization to operate successfully in this area for a long time. In fact, it is doubtful whether any further attempts should be made to organize a cooperative in this area at any time in the near future. It is likely that more progress will be made by doing everything possible to work with the existing marketing agencies in an effort to improve the services they are rendering than in trying to organize a competing organization.

Outside of the main Copiah County trucking area there are other and smaller markets for vegetables. Two of these markets are at Laurel and Hattiesburg. There is only one main buyer in each of these markets. The main vegetables handled in these markets are string beans and various types of greens, but some cabbages and Irish potatoes are handled at each place.

The largest market for Irish potatoes is at Columbia in Marion County. Almost all the potatoes produced in Marion County are handled by three potato dealers in Columbia. These dealers follow the practice of grading the potatoes as they are brought in from the farms. After the potatoes are graded the farmers are paid on a graded basis. The dealers load the potatoes in cars and attempt to sell them on an f. o. b. shipping point basis. There are also considerable quantities of Irish potatoes shipped from Tylertown in Walthall County and from Bassfield in Jefferson Davis County. The marketing process in these two areas is very similar to that indicated for the Columbia potato market. Outside of these three main shipping points there are usually from 1 to as many as 20 carloads of potatoes shipped from each of the 20 to 25 shipping points in southern Mississippi. For the 11-year period from 1931 through 1941, there was an average of 421 carloads of Irish potatoes shipped from Mississippi each year.

Even though sweetpotatoes have been grown and sold rather generally throughout Mississippi for a long time, there has never been a well organized marketing system developed for handling this crop. For the most part, sweetpotatoes are sold to local stores or to truckers who haul them from the hill sections into the Delta or to out-of-state markets. The potatoes produced for sale in most of the areas have not been of sufficient volume to justify the establishment of an efficient marketing organization. In the past, many of the potatoes have been sold green at digging time or have been stored in banks on the farm. There is usually considerable loss when potatoes are banked, and after being removed from the banks the sweetpotatoes do not keep satisfactorily. This system has resulted in placing on the market sweetpotatoes that are often of questionable quality. The shipment of sweetpotatoes in carload lots has almost completely ceased in Mississippi. For the 3-year period, 1939 to 1941, there was an average of four cars per year shipped from the State. By way of comparison, in 1931, 201 carloads of sweetpotatoes were shipped from the State. Some of this decrease is offset by increased movement by trucks.

The increased competition from high quality potatoes put on the market from other areas has resulted in a complete loss of almost all the out-of-state markets to Mississippi farmers. There is little question but that Mississippi farmers can produce and supply the markets with good quality sweetpotatoes. However, the production and marketing of high quality sweetpotatoes for table use has to be accompanied by a rather rigid system of supervision and inspection. This is true because the consumer of sweetpotatoes in Northern markets demands a rather plump, medium-sized potato that is relatively free of strings and waste. In developing outlets for sweetpotatoes only the most desirable sizes should be offered to the trade. The demand for the sweetpotato is constantly increasing and will probably increase at an even faster rate after the present war is over.

There seems to be no good reason why Mississippi farmers cannot profit by this increased demand for sweetpotatoes. In order to take advantage of this demand it will be necessary to have sweetpotatoes produced in concentrated areas in sufficient quantities to justify the establishment of an efficient marketing system. Along with such a system it will be necessary to have a rather rigid system of government inspection to insure that only the better quality potatoes are put on the market.

To be marketed most advantageously the sweetpotato must be handled in properly constructed curing and storing houses. The Extension Horticultural Department estimates that there are around 500 curing and storing houses in Mississippi, having an average capacity of around 600 bushels or a total capacity of about 300,000 bushels of sweetpotatoes. It is expected that an additional 500 houses will be constructed this year as a result of the present sweetpotato program. If done, it will give a total curing and storing capacity on the farms for around 600,000 bushels of potatoes.

During 1942 Mississippi produced about 7,000,000 bushels of sweetpotatoes. Normally only around 25 to 30 percent of the crop is sold. It is readily seen that the prospective storage capacity is sufficient to handle only a small proportion of the total crop. The storage houses are scattered over a rather large area, though it is likely that there will be enough concentrated in an area or two in the State to provide sufficient volume to develop an efficient marketing organization. If this development is encouraged and given the proper supervision and inspection, there is a very good chance that Mississippi can regain its rightful place in the sweetpotato markets.

Vegetables for processing are produced in considerable quantities in some areas in southern Mississippi. There were eight canning plants, one pickle factory, and one starch plant in operation in 1942. The

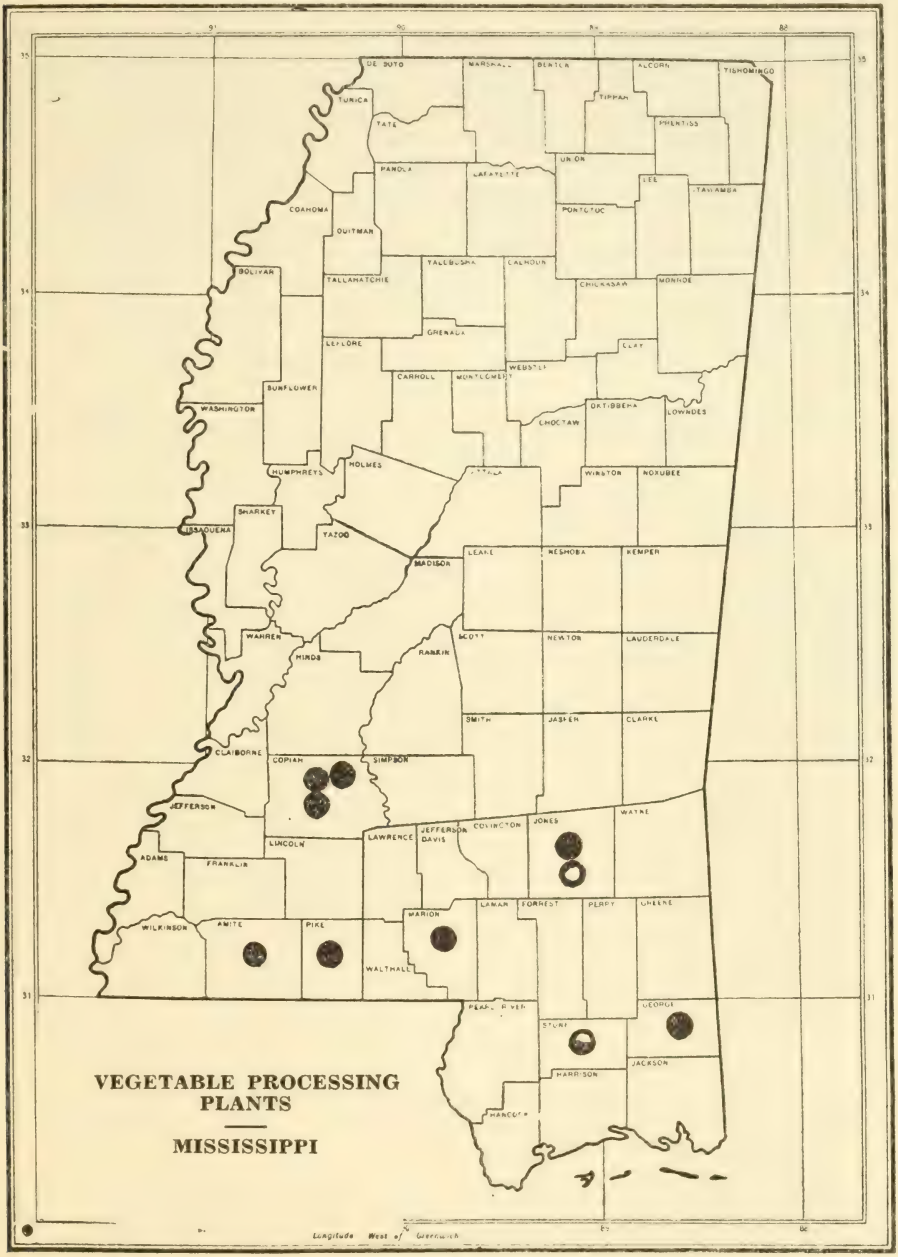

Figure 25. Location of vegetable and potato processing plants in Mississippi in 1942.

● Canning plants

◒ Pickle plant

○ Starch plant

location of these plants is shown in figure 25. The tonnage of the various kinds of products canned by the canning plants in 1942 is shown in table 21. On the basis of tonnage of the raw products canned, sweetpotatoes, string beans, tomatoes, and spinach were the most important products processed during 1942. For the most part, the tomatoes canned are those that are left after the regular fresh tomato season is over. Almost all the other products are planted on contract especially for canning purposes. The canning plants follow the practice of contracting for processing vegetables before the crops are planted, a practice which tends to assure them a sufficient volume of produce to carry on an efficient operation each year. During years of especially high prices for the fresh produce there is some trouble on account of contract breaking and the plants have difficulty getting enough produce to operate at a profit.

Table 21—Tonnage of various products canned by eight canning plants in Mississippi in 1942

Product	Tons canned
String beans	2,766
Sweetpotatoes	3,550
Peppers (pimento)	436
Spinach	1,416
Turnips and mustard greens	613
Pole beans	310
Crowder peas	550
Beets	307
Okra	251
Tomatoes	2,091
Total	12,290

These canning plants serve as a balance to the vegetable industry. That is, the farmers in the areas where the plants are located are always assured of getting canning prices for their produce. There is not the risk of a complete loss as is often the case in the areas where vegetables are produced entirely for fresh consumption. On the other hand, there are no fabulous profits to be made in producing crops for processing. The return is usually modest but it is steady and can be counted on and planned for throughout the crop year. In an area, such as southern Mississippi, that is in between the large commercial vegetable areas, it is likely that the canning plants will continue to furnish an important part of the demand for truck crops.

In this connection it would seem wise to work toward a program that would insure a reasonable return to the canning plants each year. The farmers may see an opportunity to gain by selling to the fresh trade during some years, but their long-time welfare would probably be served best by selling enough to the plants every year to assure an efficient operation. In some instances the farmers have completely destroyed their most regular and steady markets by breaking their contracts during seasons when the prices for fresh produce were unusually good. A program for solving this problem to the best interest of both grower and canner has been suggested in a recent bulletin published by the South Carolina Agricultural Experiment Station. The program suggested is as follows:

> If fruit and vegetable growers look wisely to their long-run interests, they will not starve canneries for raw products even when the fresh-market prices are high; otherwise, no secondary market may be available when it is needed to stave off disaster. And with a little forethought and planning by the parties concerned, the problem can be solved for the benefit of both growers and canners. A general idea of an approach to the problem may be outlined as follows:
>
> Let fruit and vegetable growers contract with the cannery to deliver to it at regular intervals during the canning season a certain minimum quantity (measured by acreage, by volume, or by a formula involving both) of the product involved, and to part with it at a previously specified price. The quantity of raw products thus contracted for by the canner should be sufficient under normal conditions to keep him operating at 25 to 35 percent of full capacity (which this study indicates is usually sufficient to allow a profit). The grower should be free to raise as many additional products as he wishes for sale in the fresh fruit and vegetable markets, and the canner should have no claim on them so long as the grower delivers the contractual minimum amount to the cannery. At the same time, however, the canner should be obligated to buy all of the products produced by growers with whom he has contracts (up to his full capacity for handling raw products) at the price agreed upon for the minimum contractual amount. This would assure the growers of a secondary market at a stated price even though the price in the fresh markets should fall to a ruinously low level. It is necessary that the minimum contractual amount of raw products be less than sufficient to enable the cannery to operate at full capacity; otherwise it could not serve as a market for **additional** surplus products, and the farmers would gain no market insurance to compensate them for selling part of their product to the cannery at low prices when they could have obtained better prices elsewhere.
>
> Canners in South Carolina cannot afford to pay the average market price for fruits and vegetables, nor can they afford to stand idle because of lack of raw products during the greater parts of some seasons. At the same time, under present conditions and prices, farmers in most sections of the State cannot afford to produce fruits and vegetables solely to sell them to canneries. But if each side makes certain concessions and adjustments such as those mentioned above, it is believed that a continuing mutually profitable relationship can be established. Furthermore, as is demonstrated in a subsequent part of this report, canneries could afford to pay a higher price for raw pro-

> ducts if their volume and certainty of operations were increased.
>
> Another solution of the problem discussed above would be for the canneries to be owned by cooperative marketing associations of growers. Then it would make no difference in the permanency of the cannery whether or not it stood idle because all of the raw products were being sold at high prices in the fresh markets. The fixed costs of the cannery could be met with a part of the proceeds of such sales and the plant would always be ready to begin operations as soon as the prices of the fresh products fell to a level where it was more profitable to pack them and sell them in cans. The cost of the idle or partly idle cannery when prices are high could, under these circumstances, be designated directly as market insurance. This same type of cost is present under the other plan discussed, but it is not so clearly discernible.[1]

In addition to the produce handled by the regular canning plants, the pickle factory at Wiggins handles the cucumbers produced from 4,000 to 5,000 acres of pickling cucumbers each year. The cucumbers are contracted for in advance of the planting season each year and rarely does any one farm have more than an acre of cucumbers. There is a total of around 5,000 farms in 30 counties that produce pickles. The cucumbers are collected at some 15 brining stations and about 50 receiving stations that are located at convenient points in the pickle producing area.[2] The same price is paid for the cucumbers delivered at all these places. The cucumbers are graded and the growers get the contract price for the grades of cucumbers delivered.

From the receiving stations the cucumbers are carried to the nearest brining station or the main plant. From the brining plants pickles are delivered to the main plant in tank cars as they are needed throughout the year.

The sweetpotato starch plant at Laurel was built in 1934 by a grant from the Federal Emergency Relief Administration. The Department of Agriculture operated the plant through the Resettlement Administration and the Farm Security Administration until 1938. Since that time it has been operated as the Sweetpotato Growers, Incorporated, a cooperative organization with the operating funds loaned by the Farm Security Administration. The government has subsidized the production of sweetpotatoes for starch during most of the time since the plant started operating. Therefore, it has not been definitely established whether or not the plant can operate on its own, free of government subsidy, for any period of time. During 1942 the plant operated without subsidy and was able to pay an average of $11.67 per ton for 2,750 tons of sweetpotatoes. This was an average to the growers of $.32 per bushel.

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[1] Stepp, James M. "An Economic Study of Commercial Fruit and Vegetable Canneries in South Carolina." South Carolina Agricultural Experiment Station Bulletin No. 342, p. 29.

[2] Anderson, W. S., "Growing Cucumbers for Pickling in Mississippi," Mississippi Agricultural Experiment Station Bulletin No. 355, 1941.

It is hoped that, by branching out into other activities that will help pay the heavy overhead costs, the starch plant can become a permanent outlet for sweetpotatoes. At the present time the plant is putting in the necessary equipment to dehydrate sweetpotatoes. It is expected that as markets are developed for table potatoes the starch plant will furnish a ready market for the jumbos, strings, and other potatoes that cannot be sold to the table potato trade. Research projects to aid this development would be very desirable. The Horticulture Department of the Experiment Station and the Regional Laboratory of the United States Department of Agriculture have already conducted considerable research along these lines and their results are very encouraging.

FRUITS AND NUTS

PEACHES

From a commercial standpoint fruits have never been of any great importance in Mississippi. The latest census reports that during 1939 there were slightly over 1,000,000 bushels of peaches produced in the State. For the most part, peaches are produced in small home orchards and are used largely for home consumption.

During some years in the past rather large quantities of peaches have been shipped out of the State in carload lots. For example, in 1931 there were 123 carloads of peaches shipped from Mississippi. Since that time rail shipments of peaches have almost entirely ceased. Between 1937 and 1941 only one car of peaches was shipped to an out-of-state market. This does not mean, however, that the sale of peaches has decreased by this amount. The method of handling peaches has changed from rail shipments to movement by truck. A large proportion of the peaches that are sold are bought at the orchard by truck buyers. Many of the owners of peach orchards have roadside markets and in recent years have disposed of substantial portions of their peaches in this manner. Because of the method of selling, it is difficult to get any reliable information about the quantity and value of the peaches sold.

PEARS

In addition to peaches, small quantities of pears are produced in every county in the State. During the 1939 season there were about 280,000 bushels of pears produced. Except for a few counties in southern Mississippi, almost all pears produced are consumed in the home. More pears are produced in Pearl River than in any other county in the State. As was the case with peaches, there have been years when considerable quantities of pears were shipped in carload lots to markets outside of Mississippi. For example, in 1936, 48 carloads were shipped by rail. Between 1937 and 1941, however, only nine cars of pears were shipped to out-of-state markets. At the present time almost all the pears that are sold are bought at the orchards by truck buyers who haul them to other points within the State or to more distant markets.

STRAWBERRIES

Small quantities of strawberries are produced in some counties scattered throughout the State. They are produced in commercial quantities, however,, only in a very few areas, particularly Lauderdale County.

Based on the number of carlot shipments, the commercial importance of strawberries has been declining for the past 12 years. In 1931, 127 carloads of strawberries were sold from farms in Mississippi. Since that time there has been a constant decrease from year to year. In 1941, only 14 cars were sold. Almost all the strawberries that are sold in Mississippi move from the town of Lauderdale in Lauderdale County. They are loaded in cars at this point and are sold on an f. o. b. shipping point basis.

PECANS

During 1939 there were about 5,600,000 pounds of pecans produced in Mississippi. Pecan production is of greatest commercial importance in the Longleaf Pine, Lower Coastal Plain, and the Gulf Coastal Areas. In addition certain counties in the Delta produce considerable quantities of pecans. The heaviest producing counties are Jones, Lamar, Pearl River, Hancock, Harrison, Jackson, Coahoma, and Washington. About 1,270,000 pounds of pecans were produced in the Gulf Coastal Area in 1939.

In the Gulf Coastal Area the actual marketing of pecans is handled by three types of pecan buyers. All along the main highways, particularly around Bay St. Louis in Hancock County, there are roadside stands at which pecans of all types are sold. The operators of these roadside markets are usually pecan buyers who cater to the tourist trade. Most of them have been successful in developing a mail order business for pecans in small packages. In addition they sell shelled pecans, pecan candy, and pralines.

A second type of pecan buyer is that represented by the pecan shellers located within the State. These buyers have small pecan shelling establishments and in some cases have a retail store at which they sell all types of pecans and pecan products. These buyers usually secure most of their pecans by going from place to place and buying them from the producers. In some cases they buy pecans which are delivered to shelling plants by the producers or by pecan dealers. There are four pecan shelling plants in Mississippi. These plants are located at Gulfport, Jackson, Natchez, and Fruitland Park. During 1942 these plants shelled a total of around 2,600,000 pounds of pecans. However, not all of these were produced in Mississippi; some plants buy pecans produced in other states.

The third type of pecan buyer is represented by the agents of the large out-of-state pecan shellers. There are a rather large number of these buyers who spend their time, during and just after the pecan harvesting season, traveling from farm to farm purchasing pecans from the producers. Almost all these buyers have contracts with large shelling establishments in Texas and Missouri. The usual practice is for the shelling plants to agree to pay their agents a stated price for each pound of pecans delivered. The local agent makes the difference between this agreed price and the amount he has to pay for the pecans locally. When these agents have assembled sufficient quantities of pecans, the buying concerns usually send their trucks to the assembly point and move the pecans into the shelling plants.

TUNG NUTS

There are around 100,000 acres of tung trees growing in Mississippi at the present time. During 1939 a total of 843,252 pounds of tung nuts were produced in the State, about 95 percent of which were produced in the Lower Coastal Plain area, and about 70 percent in Pearl River County. There are three tung nut crushers in the producing area in southern Mississippi. In addition there are crushers just over the State lines in Louisiana and Alabama. For the most part the large producers of tung nuts sell direct to the crushing mills, and in many instances the smaller tung nut producers also sell direct to the mills. Especially is this true where the producers are located close to the crushing plants.

In areas located some distance from the crushing plants, there are some buyers who purchase the nuts from the producers and then resell them to the crushers. One of the largest tung nut buyers, located in Gulfport, purchases tung nuts in almost all of the southern Mississippi producing areas and resells them to crushing plants in Mississippi and Louisiana. Even though the production of tung nuts is a fairly new enterprise in southern Mississippi, it seems that fairly adequate marketing facilities have been developed.

OTHER CROPS

CORN

The production of corn has always occupied more acreas of cropland in Mississippi than any other one crop. As is true in most Southern states, however, corn is produced almost entirely for home consumption. Even though corn is produced largely for home consumption there are surplus amounts on some farms and in some areas almost every year. During particularly good crop years there will be rather large quantities of corn sold. For the most part, the selling of corn is largely an exchange between the farmers who are fortunate enough to have a surplus and their neighbors who are not quite as fortunate. In addition to this farmer-to-farmer selling, almost every year there is some corn sold to truck buyers who haul it into the neighboring states. Often the truck operators will bring a load of produce of some type into Mississippi and buy a load of corn in order to have a full truck on the return trip. Because of this method of selling, it is difficult to make estimates of the quantity or the value of corn sold. Also, because of the fact that no one area produces a surplus of corn for any number of consecutive years, there has not developed any organized marketing system.

OATS

Oats are produced rather generally throughout Mississippi but are of commercial importance only in the Delta. Oat production was started in the Delta as a means of producing feed for workstock, and are still planted mainly for that purpose; but in recent years there has been a considerable increase in commercial oat production. So far, these surplus oats have been handled in much the same way as the surplus corn. That is, they are sold from farmer to farmer or are sold directly from the farm to truck buyers who haul them to other points within the State or to points in the neighboring states. In addition to these outlets, oats are bought by some of the large feed mills both within and without the State.

In recent years three small grain elevators have been operating in the Delta, two at Greenville and the other at Inverness. The operators of these elevators buy grain outright or store it on a fee basis for the producers. The operators of these elevators have not found the demands for their services sufficient to expand their operations materially. The outlets for the oats they buy are rather limited, since they have not been able to compete successfully in the out-of-state markets in the South with the oats shipped in from other areas.

Before the beginning of the present war, a rather promising outlet was being developed by one of the elevator operators for clipped oats that were being shipped by water to points on the Gulf Coast of Florida for chicken feed. It was found that because of the relatively cheap water transportation, oats could be delivered to those points at a price that would enable them to compete successfully with oats from other areas. These shipments have ceased altogether and further developments of this market will have to wait until the close of the war.

If oats are to continue to increase in commercial importance in the Delta it will probably be necessary to develop a systematic method of marketing them within the State as well as to develop definite out-of-state markets for Mississippi oats.

SOYBEANS

It is estimated that 203,000 acres of soybeans were planted in Mississippi in 1942 to be harvested for beans. Sixty-four percent of these beans were grown in the Delta, 21 percent in the Brown Loam Area, and almost all of the remaining 15 percent were divided about equally between the Shortleaf Pine and Northeastern Prairie areas. The production of soybeans for beans has developed almost entirely since the beginning of the war.

The emphasis placed on the production of oil-bearing seeds has resulted in a tremendous increase in soybean production in Mississippi in the past 3 years. From a production standpoint soybeans compete with cotton in almost every phase of the production process from the planting of seed to the crushing of the beans. This being the case, the continued production of soybeans at the close of the war will depend very largely on the relative prices of soybeans and cotton.

Cotton farmers, like any other farmers, will not divert labor and machinery to other crops unless there is a very good chance that the income from the other crops will be more than the income from cotton. The soybeans that have been produced so far have been sold directly to the oil mills. The producers who are located close enough to the mills have delivered their soybeans to the crushing plants. In other cases, the oil mills have arranged for representatives to purchase soybeans at strategic points in the producing areas.

Because of the fact that the harvesting and crushing season for cottonseed competes with the harvesting and crushing of soybeans, there has been some difficulty in providing adequate storage space for the soybeans. At the time when soybeans are being harvested, the storage space at the oil mills is being filled to capacity with cottonseed, and but little storage space is available until some time in January or February for the beans harvested the previous fall. This problem has been fairly adequately solved by putting the soybeans in sacks and storing them on the farms or in vacant store buildings until the oil mills can take them. Some oil mills in the Delta have solved the problem by stopping the cottonseed crushing operations as soon as sufficient soybeans are available to start crushing this crop. By following this procedure, they crush all of the soybeans immediately after the harvesting season and then resume their crushing of cottonseed.

Another problem faced by the oil mills is that the adequate storage of soybeans requires a different type of storage bin from those used for storing cottonseed. If soybeans are stored in bulk in the regular cottonseed bins, the tremendous pressure exerted by the beans around the bottom of the bins usually results in considerable bulging and in some cases the bursting of the bins. Some oil mill operators have partially solved this problem by putting some of the soybeans in sacks and stacking them around the outer edges of the storage bins and then putting bulk beans in the center. This practice has been satisfactory wherever it has been tried.

From what has been said it can be readily seen that the continued successful production of soybeans for beans in Mississippi will depend very largely on the successful solution of some of these more important marketing and storage, as well as production, problems. According to reports furnished by the Mississippi Cottonseed Crushing Association, the oil mills crushed a total of 35,991 tons of soybeans during the crushing season which ended August 1, 1943. Of the beans crushed, 28,167 tons were produced in Mississippi and the remainder were shipped in from Northern and Midwestern states.

The crushing capacity of the oil mills is sufficient to handle a considerable expansion in the production of soybeans provided adequate storage facilities can be provided to take care of the beans until the oil mills can take them. From the standpoint of the oil mills it should add much to the efficiency of their operations to be able to extend their crushing season to cover a larger portion of each year.

PEANUTS

The production of peanuts in Mississippi is another wartime venture. Previous to the outbreak of the war, only scattered small acreages of peanuts were planted anywhere in Mississippi. These small patches were used largely for home consumption or were used to fatten hogs. Since the beginning of the war, considerable effort has been expended in attempts to get farmers in some of the hill areas of the State to produce and harvest peanuts.

It is estimated that during 1942 there were about 60,000 acres of peanuts that were dug and threshed. This was an increase from 27,000 acres in 1941. The largest acreages of peanuts were planted in the hill counties in the southern part of the Shortleaf Pine Area. Thus far, however, almost all the peanuts have been planted in fairly small patches scattered over relatively large areas. Such a production pattern makes it almost impossible to harvest and thresh the peanuts economically. As is the case with soybeans, peanuts compete almost directly with cotton in every phase of the production, harvesting, and crushing processes.

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If to these difficulties are added the additional problems brought about by harvesting and threshing small plots scattered over a large area, it is little wonder that farmers have been reluctant to accept their allotments of peanuts. The problems in connection with the harvesting and marketing of peanuts in Mississippi have been discussed in some detail in a recent publication by this Station.[1] It is pointed out in this report that there are opportunities for the successful introduction of peanuts as a profitable enterprise on some of the farms in the hill sections in southern Mississippi. The success of this enterprise, however, will depend on having the peanuts produced in large enough acreages on farms in fairly concentrated areas so that the harvesting and threshing process can be done efficiently.

During the war period and while the price of peanuts is fixed by the government at a fairly high figure, farmers may make some profit in spite of the inefficiency of the peanut harvesting and marketing process. It is too much to expect, however, that Mississippi farmers can successfully compete with peanut producers in the old established areas when the war is over, unless ways and means are introduced that will improve the present harvesting and marketing process.

FORESTRY PRODUCTS

The 1940 Census of Agriculture reports that 10,782 farmers in Mississippi sold a total of $1,274,194 worth of forestry products during 1939. As indicated earlier (table 1) the value of forestry products sold amounted to only 1.1 percent of the total value of all agricultural commodities sold during 1939. There is considerable evidence to indicate that this figure is too low. The Mississippi Department of Agriculture estimates that during 1942 there was a farm income from forestry products of around $20,000,000.[2]

The Severance Tax Division of the State Tax Commission in its annual report of tax collections for the year ending with May 1943 reported that for the previous 3-year period Mississippi forests produced a total of 7,405,260,497 board feet of forest products. This is an average of 2,500,000,000 board feet per year of all types of forest products converted to a board feet equivalent. Severance taxes were collected at the rate of 3 percent of the value of the products at the point of severance. During the 3-year period $882,349 were collected in taxes. This means that taxes were collected on a total of $29,411,623 worth of products for the period, or an average of $9,803,874 per year. These values are at the place of severance and are therefore, stumpage values. The amount and value of the forest products, by groups, that were sold during the period from June 1, 1942 to May 31, 1943 are shown in table 22.

Eighty-five percent of the total value of products on which severance taxes were collected was from logs. The report of the Severance Tax Division indicates, however, that the production of lumber has decreased during the past 3 years and the production of pulpwood has increased.

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[1] McComas, P. S., O'Kelly, J. F., Welch, F. J.: "Peanuts for Oil," Agricultural Experiment Station, State College, Mississippi, Bulletin 376, March 1943.

[2] "Mississippi, Agricultural and Statistical," State Department of Agriculture, Jackson, Mississippi, June 1943.

Table 22—The amount, taxes collected, and total stumpage value of forest products sold in Mississippi for the 1942-43 tax year, by class of product

Class	Amount	Unit	Taxes collected	Rate per unit, cents	Total stumpage value
Logs	1,713,244,050	B. F.	$253,088	14.7	$8,436,263
Poles and piling	38,902,332	B. F.	8,169	21.0	272,316
Pulpwood	348,043,600	B. F.	26,103	7.5	870,109
Cordwood special	20,903,500	B. F.	5,017	12.0	167,230
Stumps and lightwood	503,076	Tons	3,773	.75	125,769
Turpentine	25,023	Bbls.	751	3.0	25,023
Total	----------	---	$296,901	-----	$9,896,710

Source: Third Annual Report, Timber Severance Tax Division, State Tax Commission, Jackson, Mississippi, for June 1, 1942 to May 31, 1943.

The first year (1940-41) the Severance Tax Law was in force, taxes were collected on 456,937 cords; during the most recent year (1942-43) taxes were collected on 911,917 cords of pulpwood.

A further indication of the importance of the forestry enterprise to the people of Mississippi can be had from a brief survey of the wood-using industries in the State. The distribution of the saw mills and other users of basic forestry products is shown in figure 26. According to the Mississippi Index of Manufacturers there were 1,067 sawmills and other businesses such as crate mills in the State in 1941. These basic timber-using industries are scattered throughout the State but there are definite concentrations in several counties in the northeastern corner of the State and in the southern counties of the Shortleaf Pine area. The entire southern portion of the State is served by a large number of sawmills which are rather uniformly distributed. These sawmills range in size from very small portable outfits that cut less than 3,000,000 board feet of lumber annually to the very large mills, a number of which cut more than 10,000,000 board feet annually. The sawmill buyers furnish a ready cash market for almost any type of timber that can be produced in Mississippi.

Another indication of the importance of the lumbering industry in Mississippi is given by the fact that in 1941 there was a monthly average of 28,603 workers employed in the lumber and timber basic products industry. These workers received an annual wage of $20,387,791 during 1941, according to the annual report of the Mississippi Unemployment Compensation Commission. In addition to the regular lumber and timber using industries, there are four pulpwood plants in the State, as shown in figure 26. These plants, located at Greenville, Meridian, Laurel, and Moss Point, employ a total of approximately 8,000 persons and have pulpwood buyers located in almost every county in the State. Usually these buyers will purchase the pulpwood on a stumpage basis and cut it and haul it themselves, or they will buy it at a specified amount per cord delivered to the nearest railroad station. Through this system a large proportion of the farmers in Mississippi have ready access to a

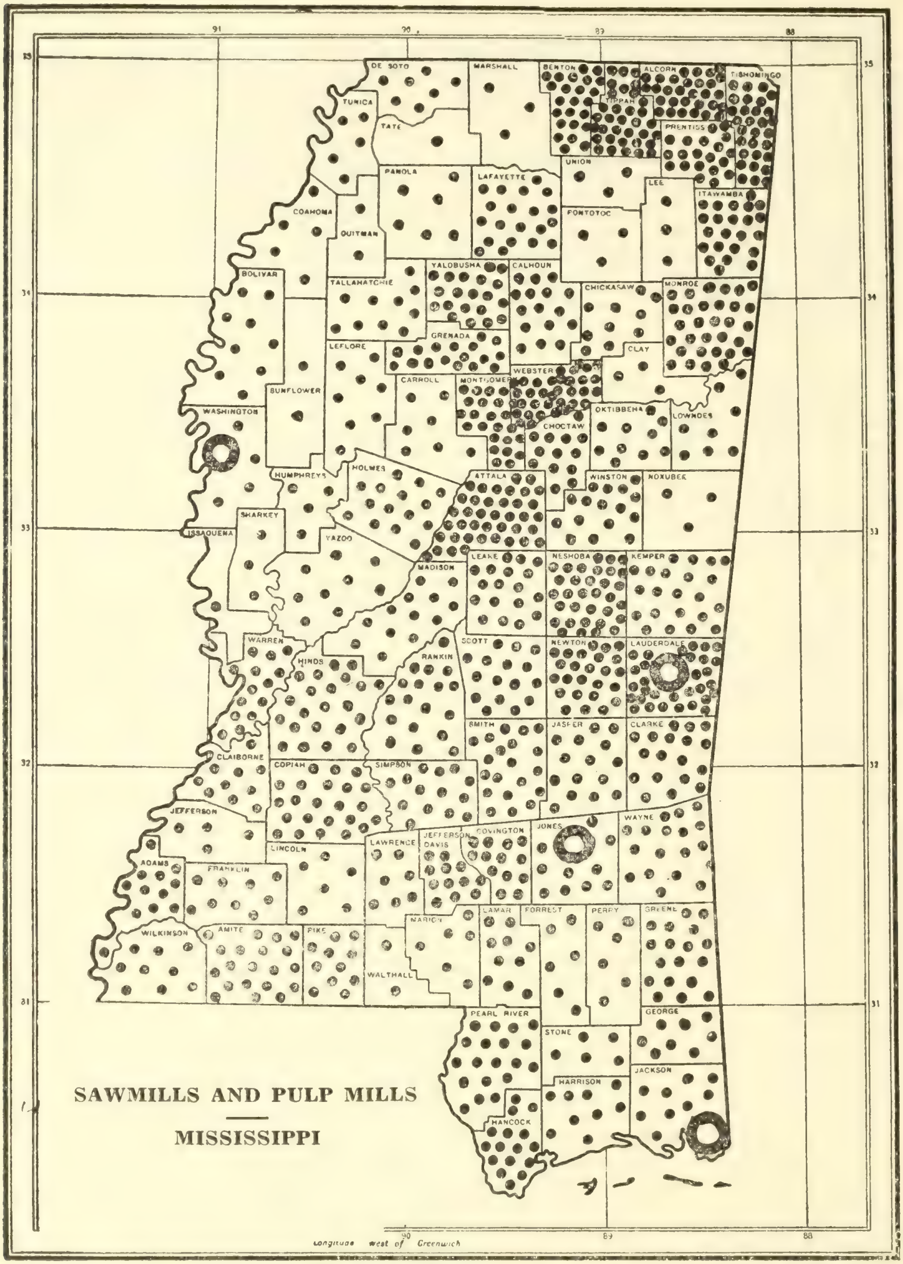

Figure 26. Distribution of sawmills and pulp mills in Mississippi in 1941.

● Sawmill

○ Pulp mill

Source: Mississippi Index of Manufacturers, Miss. Board of Development. Post-War Planning Atlas, Southeast Region, USDA.

cash market for their pulpwood.

In the past, the process of marketing forestry products has been such that many areas have been completely deforested. The practice of clean cutting has been followed rather generally for many years and has been encouraged by many small and some large sawmill operators. From the standpoint of sawmill operators, it is usually less costly to cut a block of timber clean than it is to do selective cutting, because the timber cutting and hauling crews can be more fully occupied in the actual process of cutting and hauling trees if they can take everything as they come to it, than they would be if they had to skip about and take only a tree here and there.

In many areas the sawmill operators have refused to buy timber if the producers insisted that they do selective cutting or have offered less money for their timber to farmers who wanted to do selective cutting. Another method used by sawmill operators in some areas to force the farmers to allow them to do clean cutting, is what might be called the "squeeze plan." That is, an operator with a portable sawmill will move to a community and start cutting the timber on those farms where the farm operators will allow him to do clean cutting. As the cutting progresses, the sawmill operator indicates that he will not buy any timber unless he can "take it all," and that those farmers who want to do selective cutting can wait until another sawmill comes along. Many of the farmers do not care to wait and are thus forced to sell their timber on a clean cut basis even though they prefer to sell it selectively. This practice is particularly effective in those areas that are served by small portable sawmills.

The fact that the woodlots were cut clean is not of itself so much of a crime. The real problem lies in the fact that no seed trees were left, or the land was not immediately planted in young trees. Where severance taxes are in effect, as they are in Mississippi, it is not so important for the land owner to harvest some timber each year, as is the case where ad valorem taxes are in effect. From the standpoint of efficiency in the marketing process, especially in cutting, loading, and hauling, it is much cheaper to harvest one crop of timber every 30 years than it is to go to the same plot for a few trees every year for 30 years. It may be that there is additional income from the sustained yield plots that offsets the economic advantage of clean cutting. In any case the difference is not as great for large acreages of timber as it is for small farm woodlots.

It is needless to say that a farmer with a small acreage of forest land cannot afford to own logging equipment just to harvest his own timber. Likewise it is often not practical for sawmill operators to move the necessary equipment and crews around from farm to farm to get only a few trees at each place. At least, this seems to have been the case in the past. It may be that as timber becomes scarcer and prices higher, the sawmill operators can afford to cut a few trees in a large number of places and still pay the producer a reasonable price.

There is another factor that has to be taken into account when increased prices for forest products are considered. This factor is the large number of substitutes that are available. In normal times when lumber prices get high, the users of timber and timber products make substitutions wherever it is possible to do so. The large variety of substitutes available will make it rather difficult for timber prices to continue to increase. This being the case, it is likely that the greatest opportunity for increasing the income to the farmers is by finding ways and means of producing, harvesting, and marketing forest products more efficiently. The problems faced in bringing about these increases in efficiency and at the same time keep the land from being cut clean on the small farm woodlots are difficult to solve. They are so difficult, in fact, that few men have dared to tackle them; and as far as most of Mississippi is concerned the methods of harvesting and marketing timber from the farm forests are little advanced over what they were several years ago.

The combined forces of the State College, the State Forestry Department, and the United States Forest Service together with the Southern Forest Experiment Station, have made and are making tremendous strides forward. Their most noticeable progress thus far has been with the larger producers of forest products. They are also studying the problems of the owners of farm forests. There is a great need, however, for much additional study of the marketing problems of these small producers of forest products.

In recent years the General Education Board of New York City has become interested in the problems of owners of small forests. In order to aid the development of forests and the production of forestry products in the South, this organization has made grants totaling $187,450 to five universities in the South to aid in improving facilities and in carrying on research in various phases of forestry. In these grants were $62,100 for studies by two institutions in the field of farm forestry,[2] namely, the University of Arkansas and the University of Tennessee, and are to extend over a 3-year period. They are covering in detail the production and marketing problems of the owners of farm forests.

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[2] General Education Board, New York, Annual Report, 1941, pp. 9-20.

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Sugarcane Production in Mississippi

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Sugarcane Production in Mississippi

By I. E. STOKES and T. E. ASHLEY[1]

The culture of sugarcane for sirup production has long been practiced in Southern and Central Mississippi, the sirup being used primarily for human consumption. During the earlier years Louisiana Purple, known commonly as "Louisiana Ribbon Cane," was the principal variety grown. Recently, other varieties have superseded this variety because of their high production, disease resistance, and superior sirup qualities.

Table 1 gives data concerning production of sirup in Mississippi and the United States. These data show that for the period 1930 to 1939 average production in Mississippi was 18.3 percent of the total sirup produced, while in 1940 and 1941 only 10 percent and 17 percent, respectively, were produced. Decrease in sirup production for 1940 and 1941 undoubtedly resulted from a severe freeze in January 1940, which killed much of the planted and stubble cane.

There are very few large commercial growers of sugarcane in Mississippi. Most of the cane is grown by farmers who practice general farming. Usually from one-half to three acres are used for growing sugarcane. It is a crop which fits well into a program of diversified farming because the sirup is usually made after other crops, such as corn and cotton, are harvested. Furthermore, cane usually is planted in Southern Mississippi for the next year's crop in the fall after other crops are harvested.

CULTURAL PRACTICES

Soils

Well-drained sandy loam soils with an abundant supply of organic matter are best suited for sugarcane production. Such soils provide good drainage, encourage good growth, are relatively high in moisture-holding capacity, and are easily cultivated. Usually those soils known as "second bottom land" are most suitable for growing cane. Poorly drained heavy soils usually result in poor stands, low yields, and a poor quality of sirup. Conditions associated with heavy soils favor the development of diseases such as root rot and red rot. Low yields are also usually secured on light, deep sandy soils that are deficient in organic matter and low in moisture-holding capacity.

Land Preparation

Since plant and succeeding stubble crops of sugarcane usually occupy the same land for 3 to 4 years, it is important that the land be well broken and prepared before planting. It is suggested that the land be flat-broken to a depth of 4 to 6 inches 6 to 8 weeks before

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Table 1. Average, yield, and production of sugarcane for sirup—average 1930-39, annual 1940 and 1941 for Mississippi and the United States.[1]

	Acreage harvested for sirup			Yield per acre of sirup			Production		
	Average 1930-39	1940	1941	Average 1930-39	1940	1941[2]	Average 1930-39	1940	1941[2]
	1,000 acres	1,000 acres	1,000 acres	gallons	gallons	gallons	1,000 gallons	1,000 gallons	1,000 gallons
Mississippi	26	15	19	154.0	90.0	165.0	4,017	1,350	3,135
U. S.	137	102	113	159.4	131.5	162.6	21,948	13,415	18,374

[1] U. S. Department of Agriculture—Agricultural Statistics, 1942, page 151, table 195.

[2] Preliminary.

planting. Just before planting, the land should be bedded into rows 4 to 5 feet apart leaving a clean furrow in which to place the cane.

Planting

In Southern Mississippi, planting is usually done in November. Spring planting, usually in March, is practiced in Central Mississippi.

In order to protect the "eyes" of the nodes the cane should not be stripped. The shucks will rot before germination in the spring and will in no way hinder a good stand.

It is recommended that the cane be planted at the rate of one and one-half to two stalks; that is, the stalks should be placed end to end with a half stalk or whole stalk at the union. Crooked stalks should, after having been placed in the furrow, be cut sufficiently to make a straight line (see figure 1). If this practice is followed, it will make for easier cultivation after the cane has come up.

Cover the fall planted cane to a depth of from 7 to 9 inches with a turning plow, using a sufficient number of furrows to provide a good middle between the rows. It is important that the last few furrows be plowed rather deep to insure good drainage around the seed stalks. In addition, if the stalks are well covered with soil, ample protection will be provided against cold injury during the winter months. Cover spring planted cane with from 2 to 4 inches of soil.

Cultivation

Cultivation should begin in the early spring as soon as danger of frost has passed or soon after a few of the "eyes" show evidence of germination. The first cultivation consists of barring off the rows and harrowing them down to where the cane is covered to a depth of from 2 to 4 inches. The harrowing may be done with a spring tooth cultivator, run

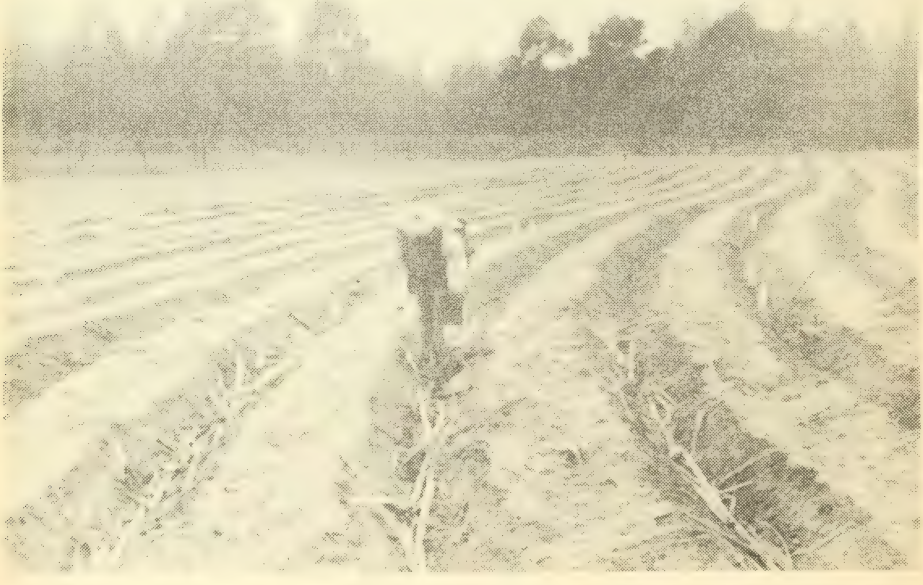

Figure 1. Cutting sugarcane stalks in furrow at time of fall planting, at South Mississippi Branch Station, Poplarville, Mississippi.

lengthwise the rows, or with a section harrow, run crosswise over the rows After the rows have been harrowed down the cane should be barred off leaving the rows about ten inches wide. This will permit the soil immediately around the cane to warm up, thereby promoting germination and encouraging growth early in the spring. After the cane has come up and reached a height of from 8 to 12 inches, the first application of fertilizer should be made. Frequent shallow cultivations should be given throughout the growing season to control grass and weeds. The beds should be kept relatively flat in order that suckering of the cane will not be hindered. A heel sweep is a good implement to use in cultivating the cane to control the weeds and to keep the beds flat. The rows of cane should be kept free from weeds and grass by hand hoeing from time to time

If the stubbles are to be kept for a succeeding crop, they should be covered with soil to a depth of from 5 to 7 inches by using a turning plow. This operation is done after the cane has been harvested. The next spring, the same operations as those outlined for planted cane should be followed in cultivating the stubble crop.

FERTILIZATION OF SUGARCANE IN MISSISSIPPI

Most farmers find it necessary to apply commercial fertilizer in order to secure a good growth of sugarcane in Mississippi. Soils, on which sugarcane is grown, differ greatly throughout the sugarcane growing area of the State. Fertilizer practices are accordingly different for different soil types and localities.

Nitrogen in some form is usually required in order to secure a good growth of sugarcane. The rate of application varies, in most cases, from 20 to 50 pounds per acre. The most profitable application is influenced largely by the soil type and previous crop history of the land. It is also important, in selecting the source of nitrogen, to use a fertilizer that is readily available and imparts no harmful characteristics to the sirup.

Phosphoric acid causes a favorable response, in the growth of sugarcane, on most soils in the State. The rate of application usually varies depending upon specific soil requirements, from 40 to 80 pounds per acre.

Potash gives little or no response on most soils in the sugarcane area of the State. However, many farmers apply potash at the rate of 20 to 50 pounds per acre.

Organic fertilizers are used advantageously in fertilizing sugarcane, cottonseed meal in particular, which is generally considered to exert a favorable influence on the quality of sirup, frequently being applied at rates varying from 300 to 500 pounds per acre. Nitrogen becomes available slowly from cottonseed meal, and it is usually necessary to supplement it with other fertilizers in which nitrogen is present in readily available form.

The general fertilizer practice in Mississippi usually involves one or two applications of a mixed fertilizer. Several fertilizer mixtures are utilized throughout the State, but the most common mixture is probably 4-8-4. The rate of application of 4-8-4 mixture varies from 500 to 1000 pounds per acre in accordance with the fertility of the soil. Heavy soils (bottom land) usually require less fertilizer than the light sandy, upland soils

Sugarcane is planted in the central part of Mississippi during the spring months Fertilization of spring planted cane usually involves an application of from 300 to 500 pounds per acre of a 4-8-4 mixture at the time of planting. The fertilizer is placed in the furrows and stirred thoroughly with the soil prior to planting the stalks. Where cottonseed meal is used as a fertilizer the same method of application is followed.

Sugarcane is planted in the southern

part of the State during the fall. No fertilizer is applied at the time of planting. The first application of fertilizer is made in the spring after the rows have been barred off and the plants have reached a height of from 8 to 12 inches It has been a common practice to distribute the first application of the 4-8-4 mixture uniformly on each side of the row in the barred off furrows at the rate of from 300 to 500 pounds per acre.

The 4-8-4 mixture will not be available in Mississippi during 1944, and equal amounts of plant food will be supplied by applications of 240 to 400 pounds of 5-10-5 fertilizer per acre.

A side dressing of from 300 to 500 pounds of fertilizer is applied, usually during the month of June, to spring and fall planted cane by evenly distributing the material on each side of the row. Preliminary results from fertilizer experiments conducted at Poplarville and Meridian indicate that, except in very dry seasons, there is a beneficial response from the side dressing.

The rate and method of applying fertilizer to fall planted cane, described above are also followed with succeeding stubble crops. A slightly higher application of fertilizer is usually required, to secure a good growth of stubble cane, than for the plant cane crop.

Green manure crops such as soybeans, cowpeas, Austrian winter peas, and vetch may be used advantageously in the production of sugarcane. The green manure crop should be plowed under so that all of the material is thoroughly rotted well in advance of the time of planting. It is possible, in most cases, to reduce the amount of commercial fertilizer applied when a green manure crop is used.

Because of widely varying soil types and soil fertility in Mississippi it is not feasible to recommend kinds and quantities of fertilizer which will prove most suitable for sugarcane under all conditions. The above mentioned mixture and quantities are given merely as an example of practice which has proved suitable in numerous instances.

VARIETIES OF SUGARCANE IN MISSISSIPPI[1/]

One of the most important factors in the production of sugarcane sirup is the variety that is grown. For sirup making, a satisfactory variety of sugarcane should possess the following qualities: "(1) early maturity; (2) a large yield of stalks; (3) a high percentage yield of juice; (4) juice having a large proportion of solids, mostly sugar; (5) light-colored stalks (green or yellow) which do not impart a dark color to the sirup; (6) resistance to diseases both during growth and while in winter storage for spring planting; (7) good germinating and stooling qualities; (8) good ratooning qualities, that is, coming up freely from the stubble after the first year; (9) strong erect habit of growth, not readily lodging in storms; (10) a fairly soft stalk relatively low in fiber. In addition, it is desirable for sugarcane to have a measure of resistance to cold so that it is not necessary to harvest and windrow all of the cane immediately after the first moderate freeze in early winter." The requirements present a difficult task to the plant breeder in attempting to combine all of the desirable characteristics in one variety. Such attempts have been made during a period of several years by the Department of Agriculture with the development of some improved varieties and the prospect of eventually developing varieties that are better suited for culture for sirup production.

One phase of the sugarcane experimental program, conducted by the Department of Agriculture at the U. S. Sugar Plant Field Station at Meridian, Mississippi,

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[1/] Quotation related to desirable qualities of sugarcane for sirup production was taken from U.S.D.A. Circular 284 entitled "Sugarcane for Sirup Production."

and, in cooperation with the Mississippi Agricultural Experiment Station at the South Mississippi Branch Station at Poplarville, has been the testing of hundreds of sugarcane varieties to determine their adaptability for sirup production in Mississippi. Average yield data for several relatively new varieties which are now grown extensively in Mississippi are shown in table 2.

Co. 290, an imported variety introduced by the U. S. Department of Agriculture, is now grown commercially in most of the sugarcane producing counties of the State. It is a green cane with a blush of reddish purple. From a distance it appears blue because of the waxy layer. The habit of growth is erect with usually straight stalks which are generally longer and larger in diameter than those of P. O. J. 213. It is relatively late in maturing and somewhat susceptible to drought and freezing injury. The lower portions of the stalks have a relatively high concentration of sugar. The fiber content is low and the stubbling qualities are almost equal to those of C. P. 29/116. This cane strips easily.

C. P. 29/116, a variety bred by the U. S. Department of Agriculture, has consistently given good yields of sirup in Mississippi. It has an erect habit of growth and generally straight stalks which are about as long and large in diameter as those of Co. 290 and are green to greenish yellow, taking on a darker yellow where it is exposed to the sun. Like Co. 290, this variety has a low fiber content. It usually produces a better stubble crop than Co. 290, especially as second year stubble. The leaves strip readily.

P. O. J. 213, an imported variety introduced by the U. S. Department of Agriculture, proved suitable for culture in Mississippi for several years after having been introduced into the State. It is still grown to a limited extent but because of its injury by strains of certain diseases which are prevalent in Mississippi it is not recommended for culture.

C. P. 31/511, a variety bred by the

Table 2. Yields of three varieties of sugarcane representing the average of typical tests at Poplarville and Meridian.

Variety	Poplarville[1]			Meridian[2]		
	Yield of cane per acre	Sirup per ton of stalks	Yield of sirup per acre	Yield of cane per acre	Sirup per ton of stalks	Yield of sirup per acre
	Tons	Gallons	Gallons	Tons	Gallons	Gallons
			Plant cane, 1942			
Co. 290	24.75	19.72	488	28.33	17.65	500
C. P. 29/116	21.00	18.09	380	28.08	19.84	557
P. O. J. 213**	15.50	18.90	293	10.68	16.67	178
			First year stubble, 1941			
Co. 290	23.40	19.02	445	33.48	20.49	686
C. P. 29/116	23.70	21.69	514	31.05	19.97	620
P. O. J. 213**	11.00	19.36	213	14.50	18.21	264
			Second year stubble, 1939			
Co. 290	19.00	20.58	391	22.89*	20.49	469
C. P. 29/116	27.00	21.74	587	28.20	22.62	638
P. O. J. 213**	11.50	11.57	133	8.00	20.62	165

**Test discontinued—results from tests during previous years.

*Results from 1938 tests.

[1] Test conducted on Ruston sandy loam soil.

[2] Test conducted on Kirvin sandy loam soil.

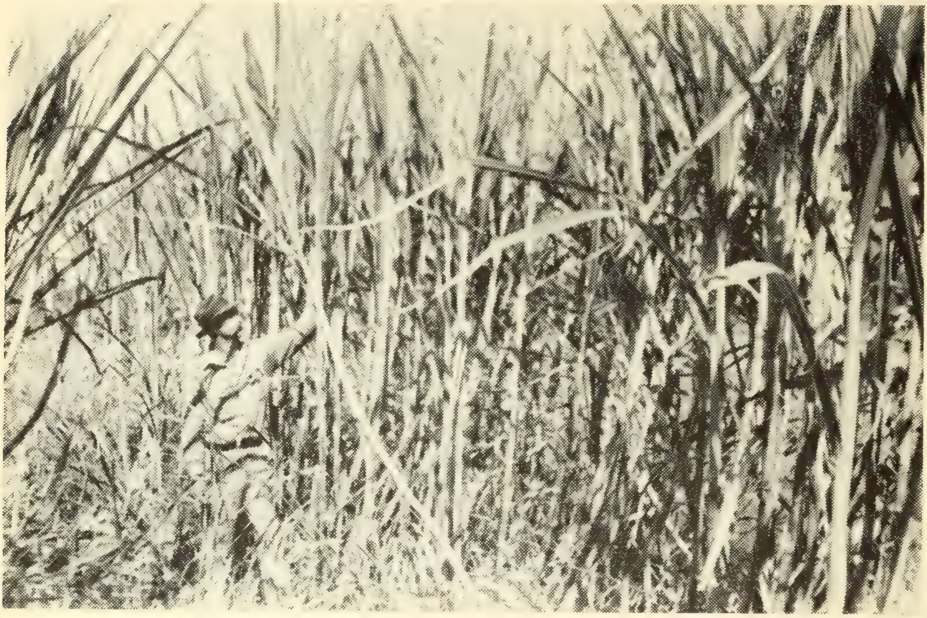

Figure 2. Second year stubble crop of C. P. 29/116 at South Mississippi Branch Station, Poplarville, Mississippi.

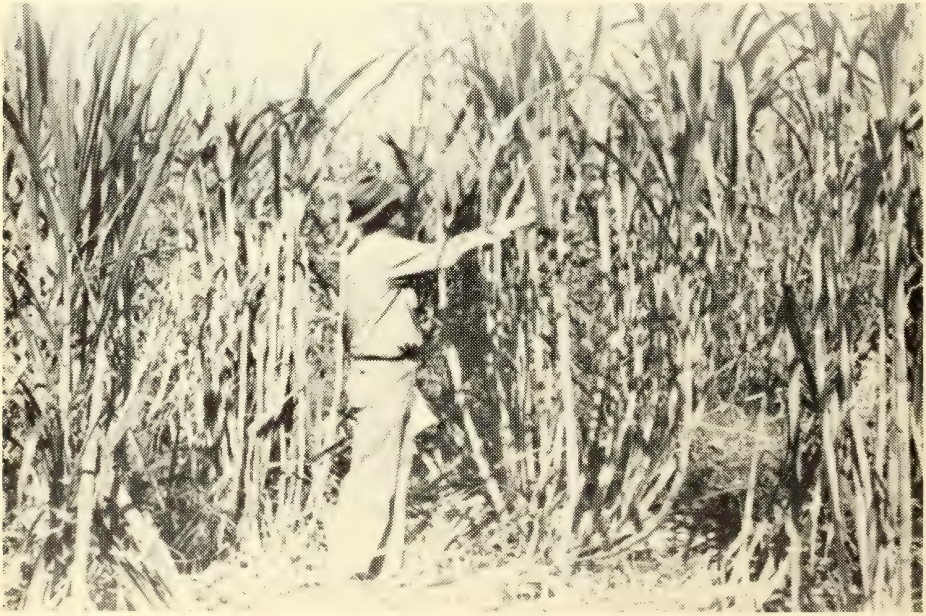

Figure 3. Second year stubble crop of Co. 290 at South Mississippi Branch Station, Poplarville, Mississippi.

U. S. Department of Agriculture, was introduced in Mississippi during recent years for culture as a chewing cane. It is a purplish red variety, the stalks of which are about as long and as large in diameter as those of Co. 290. It is very resistant to, if not immune to, the mosaic disease. Yields of cane and sirup per acre from this variety are generally lower than from C. P. 29/116 and Co. 290. Average yields are usually better in the southern part of the State than in the Meridian area. Sirup from C. P. 31/511 has a good flavor but is dark red in color. The variety is recommended primarily as a chewing cane.

Louisiana Purple ("Louisiana Ribbon Cane," "Blue Ribbon Cane") continues to be grown to a very limited extent. Because of its extreme injury by the mosaic disease, with resulting low yields of cane and sirup per acre, culture of this variety should be discontinued.

HARVESTING

The time to harvest the cane is determined largely by the prospective date of the first killing frost. The cane should be allowed to grow as late as possible, yet on the other hand it should be harvested before severe damage from frost. In general, the cane harvest begins from November 1 to November 10, depending on the amount to be harvested. It is important that the cane be stripped clean and topped uniformly at the uppermost mature joint. If this practice is followed it will result in a better quality of sirup because less sediment and "green" juice will have to be contended with. Harvesting cane by hand is accomplished either by cutting the stalk and then removing the leaves and the top or by removing the leaves and the top prior to cutting the stalk. Figure 5 illustrates the latter procedure, which is commonly followed in Mississippi. The cane should be cut with a sharp tool, either a hoe or cane

Figure 4. Plant cane crop of C. P. 31/511 at South Mississippi Branch Station, Poplarville, Mississippi.

knife. A clean smooth cut should be made at the ground level. Cutting at that point reduces stubble injury and also results in increasing the yield of sirup per acre as compared with the yield secured when the cane is cut several inches above ground level.

MANUFACTURE OF SUGARCANE SIRUP[1]

Although the quality of sirup depends to a large extent on the variety of sugarcane, maturity of stalks, type of land on which the crop is grown, the fertilizer used, and the kind of growing season it may also be greatly influenced by the equipment and the process used in manufacturing and by the skill of the sirup maker.

Several types of mills are used in Mississippi. Where the sugarcane crop is less than 2 acres a small upright three-roll mill propelled by animal power is ordinarily used for crushing the stalks. Larger mills, usually with three rollers in a horizontal position, propelled by motor or engine are used when larger quantities of sugarcane are involved. In any case, extraction of juice should, when possible, be not less than 50 to 60 percent; that is, a hundred pounds of stalks should furnish not less than 50 to 60 pounds of juice. A lower extraction, which is often secured on small mills operated by animal power, results in a loss of sirup from the sugarcane. The most satisfactory type of mill is one that is simple and efficient in operation and easily repaired.

Open type sirup evaporators are gen-

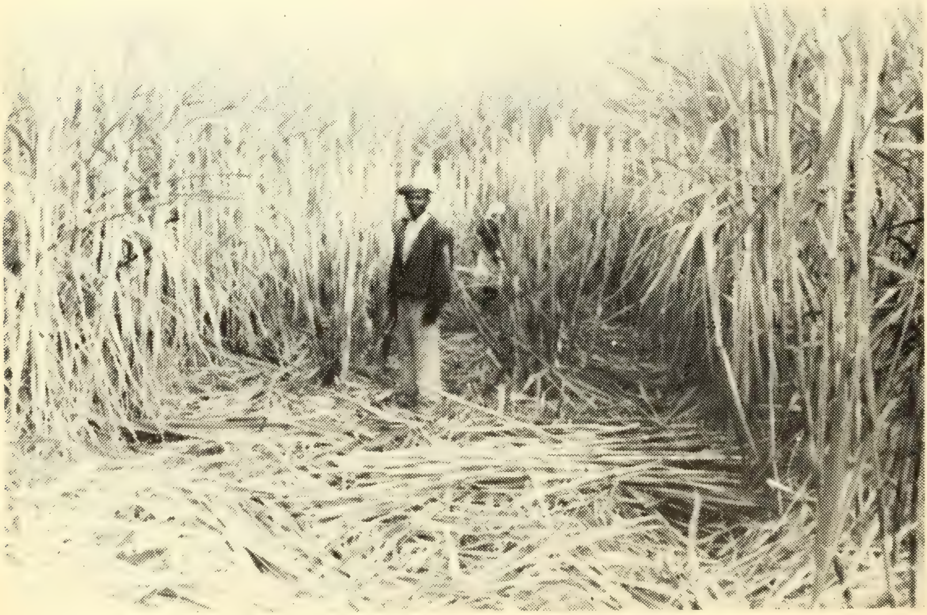

Figure 5. Sugarcane stripped, topped, and ready for cutting.

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[1] Investigations on processes of making sugarcane sirup are conducted by the Division of Agricultural Chemical Research, Bureau of Agricultural and Industrial Chemistry, Agricultural Research Administration, U. S. Department of Agriculture. More detailed information may be secured from that Division and from Farmers Bulletin 1874, entitled "Farm Production of Sugarcane Sirup."

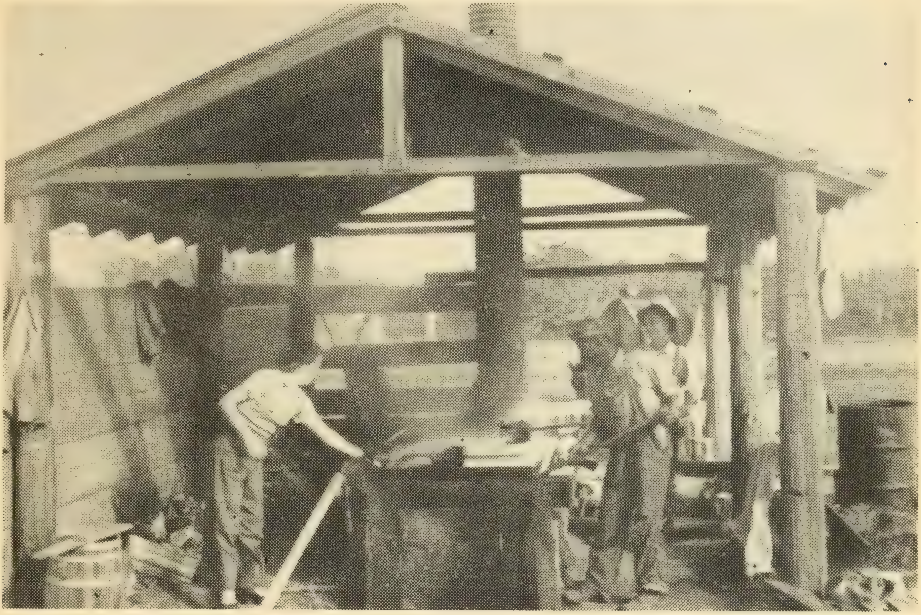

Figure 6. A continuous type sirup evaporator equipped with wood skimming board.

erally used in Mississippi. The evaporators are made from either copper or galvanized iron. Most of the evaporators are of the continuous type; that is, cold juice enters one end and finished sirup flows out of the other end continuously

Many of the continuous type evaporators are equipped with skimming troughs. Some sirup makers prefer skimming troughs made from wood (figure 6); however, metal troughs are used extensively. In either case, the skimming troughs are placed on the outside of the evaporator. Bottoms of the skimming troughs slope from the top of the sides of the evaporator at the sirup end to a fall of about two inches at the juice end. Sides of the evaporator should, when skimming troughs are used, be not more than 5 inches high. Efficiency of the skimming troughs depends upon the construction and operation of the furnace in such a manner as to cause the semi-sirup to boil high and flow over the sides of the evaporator. The upward movement of the boiling juice and semi-sirup carries skimmings to the surface and over the sides of the evaporator into the skimming troughs where they are removed. The skimmed juice and semi-sirup flows back into the evaporator. Skimming troughs reduce to a minimum the skimming operations and aid in reducing sediment in the sirup.

It is important that the evaporator be kept clean by removing sediment that accumulates on the bottom throughout each day. Copper evaporators are easily cleaned with dilute muriatic acid. Galvanized evaporators require scraping lightly and the use of hot water. Muriatic acid will damage galvanized evaporators.

It is important that sirup be drawn off at a uniform density. Many experienced sirup makers determine the density by general appearance and other simple tests During recent years, since new varieties of sugarcane have been used instead of the old established varieties, some difficulty has been experienced in determining the exact density by simple tests because the sirup fails to have the same color and other characteristics ordinarily used by sirup makers as guides. The density may be accurately controlled by measuring with a thermometer near the sirup draw-off valve. Sugarcane sirup should be drawn from the pan at 224 degrees Fahrenheit when the sirup is made at locations in Central and Southern Mississippi, which are approximately 500 feet above sea level. Some sirup makers use a Baume hydrometer instead of a thermometer Finished sirup of standard density registers, when at or near the boiling point, from 35 to 36 degrees on the Baume hydrometer.

Scorching of sirup causes a red color and a burnt flavor. Experienced sirup makers watch carefully for puffs of white smoke or the faint odor of scorched sirup and immediately supply sections of the pan in which scorching occurs with semi-sirup that is not as dense as that in the scorched areas.

The finished sirup should be strained through several layers of clean cheesecloth or similar material to remove as much as possible of any sediment which may remain in it.

Sirup should be placed in clean barrels or other containers while hot. When it is stored in barrels it should be placed in them at a temperature of about 120 degrees Fahrenheit. When it is stored in small cans or other containers it should be placed in them at temperatures ranging from 180 to 190 degrees Fahrenheit.

Shallow, wide top tanks or troughs are useful in rapidly cooling the sirup to canning temperatures, in settling out the heavy type suspended material, and in drawing off clear sirup of good keeping quality.

SUGARCANE DISEASES[1]

One of the problems confronting Mississippi sugarcane farmers is that of disease control. Fortunately, only three of the several diseases of this crop known to occur in the State, mosaic, red rot, and black rot, are commonly of much importance, but at times the losses sustained from one or more of these may be severe. Red rot, for example, sometimes causes considerable spoilage of banked seed cane of P. O. J. 213 and Co. 290. Mosaic affects both P. O. J. 213 and Co. 290, but these varieties are more tolerant of the disease than the old native canes and consequently the disease is much less of a problem than it formerly was.

The use of resistant varieties is the most effective method of combating sugarcane diseases and it may be expected that as the varietal improvement program of the U. S. Department of Agriculture, conducted in Mississippi in cooperation with the Mississippi Experiment Station progresses, varieties that will further reduce the hazards of diseases will be made available to Mississippi farmers. However, the control of these diseases does not rest entirely in the hands of the scientists who are producing new varieties, for the farmer himself can take very effective steps toward disease control in the way of selecting sound, healthy cane for seed, bedding it properly, planting it in a well-prepared seed bed, and giving the crop good drainage and cultivation. All of these things that may be summed up as good farming, have a very important influence on disease control.

Mosaic

Mosaic is a virus disease transmitted from diseased to healthy plants by the corn leaf aphid (corn louse) and two other species of aphids, in a manner similar to transmission of malaria or yellow fever by mosquitoes. The disease is recognized by the paleness of the leaves, which is

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[1] Information relative to diseases of sugarcane was furnished by Dr. E. V. Abbott, Pathologist, Division of Sugar Plant Investigations, Bureau of Plant Industry Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture.

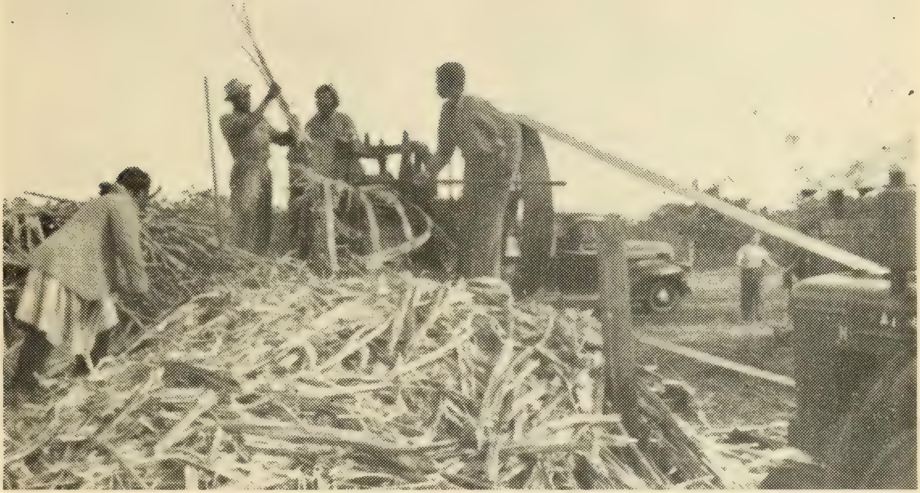

Figure 7. A motor-driven mill should be used when large quantities of cane are to be crushed.

noticeable from a considerable distance if the affected plant is carefully scrutinized in comparison with adjacent healthy plants. Examination of a single leaf from a suspected plant will reveal longitudinal streaks, irregular in size, of a green color several shades lighter than the normal green color surrounding the streaks (figure 8). The streaks may run together so that in some cane varieties they may occupy more of the leaf area than the normal colored part of the leaf. In extreme cases the normal color that remains may be restricted to isolated islands of dark green in the pale green background.

The principal damage by mosaic results from reduced germination of seed cane and stunting of growth of affected plants. These effects are much more severe in the old "native" canes than in those now generally grown for sirup.

The easiest way to minimize damage by mosaic is to plant resistant varieties. Some varieties, as for example, C. P. 29/116 and C. P. 31/511 rarely take the disease, whereas P. O. J. 213 and Co. 290 may become heavily infected, but are not markedly reduced in yield as compared with the very susceptible old varieties.

Control of mosaic is possible by seed selection and roguing out the affected plants from fields of young canes, but this method is troublesome and requires close attention. If utilized, a start should be made with clean seed cane which should be planted in a relatively isolated spot far removed from infected cane for use in establishing a supply of healthy seed cane. Beginning as soon as the cane is up, and continuing through the summer, frequent inspections should be made and mosaic-infected plants rogued out.

Red Rot

Red rot, caused by a fungus, is principally a disease of seed cane in Mississippi. In those sections where the sugarcane borer occurs, the disease may gain entrance to the stalks through the tunnels made by this insect and cause deterioration of the

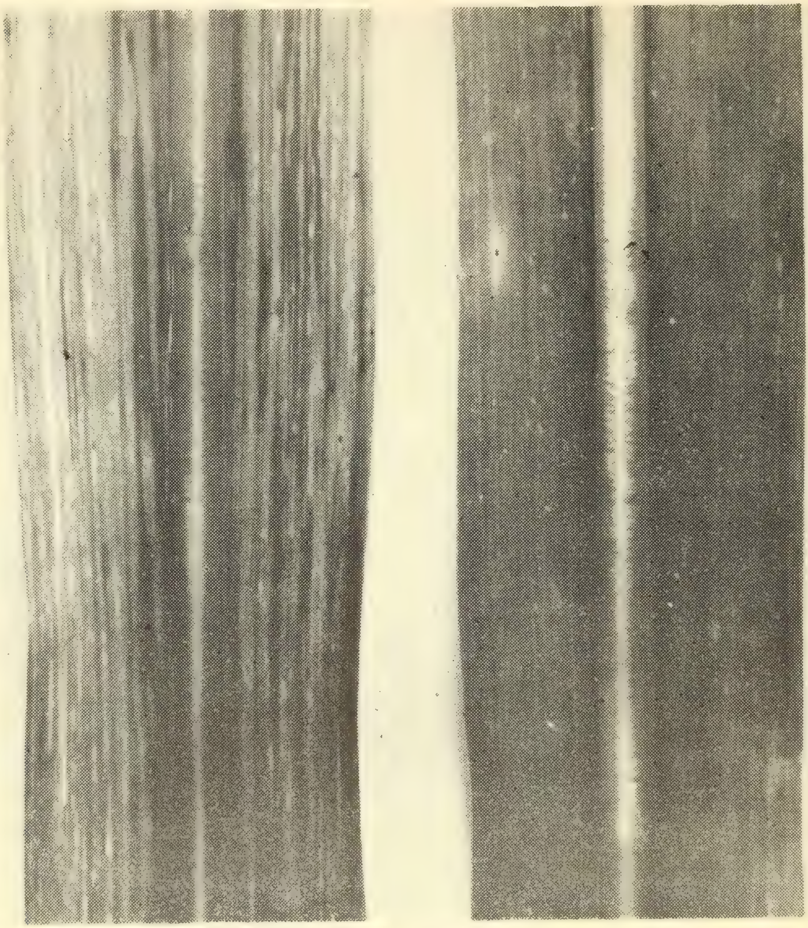

Figure 8. Mosaic disease of sugarcane (D-74). Diseased leaf on the left is pale yellow in color with streaks of dark green. Normal green leaf on the right. Photograph by Bureau of Plant Industry, Solis, and Agricultural Engineering, U. S. Department of Agriculture.

standing cane. The greatest loss occurs, however, in the beds where seed cane is stored for spring planting, and if the infected stalks are not discarded when the seed is taken up for planting, poor stands will result from the faulty germination.

Seed cane stalks severely affected by red rot generally have a dull color in contrast to the bright rind of healthy ones. Reddening of the ends of the stalks is not a sure indication of the presence of true red rot, since the exposed ends of sugarcane stalks usually become reddened after they have been cut for some time. If this red color extends beyond the first joint, however, red rot disease is to be suspected. If the stalk is split lengthwise, the disease may be recognized by the reddened interior of the stalk interrupted by occasional white patches extending crosswise of the stalk. Unless these white patches are present, identification as red rot is uncertain without microscopic examination. In advanced stages of the disease, cavities may develop, running lengthwise of the stalk, filled with a fluffy gray mold growth, which is the fungus causing the disease.

Rigid selection of seed cane should be practiced when the banks are opened in the spring and all affected cane should be discarded. Among the varieties grown at present for sirup, C. P. 29/116 is the most resistant to red rot, and thus far has shown very little damage from the disease. Losses in the seed beds with this variety have been negligible compared to Co. 290 and P. O. J. 213. This is a very important advantage which C. P. 29/116 has over the other varieties.

Black Rot

Black rot, so-called because of the dark color of the interior of affected stalks, is a disease of seed cane. It is not known to affect standing cane. It may be recognized when the seed cane is taken up from the beds in the spring by the blackened ends of the cuttings, which are sometimes covered by a fuzzy, black fungus growth. If these stalks are split, the black rot may be found affecting not only the end joints, but sometimes several joints or the entire stalk are rotted. The rotted areas have a distinct alcoholic or fruity odor, resembling that of decaying pineapples. Infected portions of the stalks should be trimmed off before planting, for the fungus will continue to spread in infected stalks after they are planted and cause poor germination. If badly affected, the entire stalk should be discarded.

As with red rot, C. P. 29/116 is less affected by black rot than are Co. 290 and P. O. J. 213.

Other Diseases

Several other sugarcane diseases occur in Mississippi, but they are generally of little or no importance. Red stripe, a bacterial disease, produces long, narrow, dark red stripes extending lengthwise of the leaves, and sometimes the sheaths also. In severe form it may affect the growing point, causing a top rot which is characterized by a very offensive odor. A similar, though usually less severe bacterial disease, mottled stripe, is distinguished by the broken or mottled red and white stripes, in contrast to the solid red stripes produced by red stripe.

Pokkah boeng, the name of which is the Malay term for damaged top, is a fungus disease, causing a distortion of the growing point in which the emerging leaves are tangled and matted together. If a diseased stalk is split, a series of cavities in a ladderlike arrangement may be found near the growing point. Some plants may be severely stunted for a while but usually they recover and resume normal growth.

Rhizome rot affects the lower portions of the growing stalks, both above and below the soil level, and is recognized by the mats of white fungus growth that cement the sheaths to the stalk. The disease is less common and less severe on the present varieties than on those formerly grown.

Root disease of sugarcane is generally of little importance in Mississippi, although where the old native canes are grown in poorly drained areas some injury may be caused. The varieties now commonly grown for sirup are more resistant to root disease than the old ones.

Chlorotic streak has not been found in Mississippi, although it has been known to occur in Louisiana since 1937. It is apparently a virus disease similar to mosaic in nature, causing, however, more serious reductions in germination and growth of the cane than generally result from that disease. It is transmitted in seed cuttings, and is spread in the field from diseased to healthy plants by a leafhopper usually found abundantly in cane fields.

Since the disease is carried in seed cane, no Mississippi farmer should risk the danger of introducing this disease by bringing in planting material from other states. Chlorotic streak can be eliminated from the stalks by treating them with hot water at 125 to 126 degrees Fahrenheit for 20 minutes, but this must be very carefully done, and should be undertaken only by the State or Federal experiment stations where the proper equipment is available. All seed cane brought into the State by the Mississppi Agricultural Experiment Station or the U. S. Department of Agriculture receives this treatment.

INSECTS ATTACKING SUGARCANE IN MISSISSIPPI[1]

Sugarcane growers in Mississippi are fortunate in that the major pest of sugarcane in the United States, the sugarcane borer, is found only in the extreme southern part of the State and the sugarcane mealybug, which is another important pest, is not known to occur in the State following its having been eradicated in several locations.

The Sugarcane Borer, Diatraea Saccharalis (Fab.)

The sugarcane borer has been found in Mississippi only in a strip 20 to 50 miles wide along the Gulf Coast and in a small area around Centreville. The larva of the insect which is the stage that causes the injury, is yellowish white with brown spots and is about one inch long when mature. The full-grown larva, that lives in the stalk, changes to a brown pupa in the tunnel made by the borer and from this tunnel the straw-colored moth soon emerges. Borer injury is characterized by the sawdust-like frass alongside the stalk at the entrance to the borer tunnels, by the tunnels in the stalks and, in the case of heavy injury, by dead and broken over tops.

The following control measures are recommended:

(1). Make a thorough clean-up of pieces of millable cane during harvesting operations to eliminate the overwintering of borers in pieces of stalks.

(2). After harvesting thoroughly burn the trash, as soon as it is dry, to destroy overwintering borers.

(3). During the winter cut and burn all large grasses, near the cane fields, in which borers might hibernate.

(4). When harvesting, cut stalks at the surface of the soil to decrease the number of borers overwintering in the stubbles. This practice also increases the yield of sirup per acre as compared with yield when the cane is cut several inches above the surface.

(5). Select seed cane that is as free from borers as possible to secure a better stand and to decrease the number of borers overwintering in planted or banked cane.

(6). For small plantings, if it can be done with little expense, soak seed cane in cold water for 72 hours prior to planting to kill the borers.

(7). Cut out and kill borers causing dead tops in late May and June.

(8). If borer injury is heavy, dust with synthetic cryolite four times at weekly intervals while the dew is on the plants using 8 pounds of dust per acre for each application and beginning when the first borer eggs of the season are hatching, which will be between April 15 and 30, or dust four times using 10 pounds per application starting when the eggs of the second generation are beginning to hatch which will be between June 15 and 30.

The Sugarcane Beetle, Euetheola Rugiceps (Lec.)

The sugarcane beetle is found throughout Mississippi. This black beetle gnaws the young plants just below the surface of the ground in the spring, often killing the plants. The following control measures are recommended:

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[1] Information related to insects attacking sugarcane in Mississippi was furnished by Mr. J. W. Ingram, U. S. Department of Agriculture, Agricultural Research Administration, Bureau of Entomology and Plant Quarantine, Divison of Cereal and Forage Insect Investigations.

(1). Plant the varieties of sugarcane that give the most prolific stand.

(2). Plow out sod areas on roadways and in adjacent pastures in the spring, if practical, to eliminate breeding grounds.

The Sugarcane Mealybug, Pseudococcus Boninsis (Kuwana)

The sugarcane mealybug is found throughout southern Florida and Louisiana and on some farms in the northern parts of these states, as well as in Georgia, Alabama, and Texas. It is not now known to occur in Mississippi.

The female mealybug, which is more commonly seen than the male, is a soft-bodied grayish insect about one-eighth of an inch long when full grown and is of a flattened-oval shape. She surrounds her body with a webby, mealy substance in which her eggs are deposited. Mealybugs are most often found on the cane feeding between the sheath and the stalk. They injure the cane by sucking the sap from the tender stalk tissues and sometimes kill the buds. Treatment of seed cane for 30 minutes in water held at 122 to 126 degrees Fahrenheit has been found to kill all stages of the mealybug. Planting seed cane treated in this manner in fields located some distance from fields of infested cane has proved effective in Mississippi, and elsewhere, in eradicating the mealybug from infested areas.

Miscellaneous Insects

Several other insects occasionally occur on sugarcane in Mississippi. A small grayish worm with three whitish longitudinal bands and with a blackish head known as fall armyworm, **Laphygma frugiperda** (A. and S.), appears at times in the spring and in the late summer or early fall and eats most of the foliage on young sugarcane plants. The lesser corn stalk borer, **Elasmopalpus lignosellus** (Zeller), a very active slender caterpillar, greenish in color with dark brown longitudinal bands, attacks sugarcane plants just above, or immediately beneath the surface of the soil causing the growing point to die. Usually the infestation of the latter two insects is limited and the damage is small.

Plant lice often attack sugarcane. Two species, the corn leaf louse, **Aphis maidis** (Fitch), usually found in the central whorl of the plant and the rusty plum aphid, **Hysteroneura setariae** (Thos.), found on the collar lobe serve to spread the mosaic disease. In general, the direct influence of plant lice is not serious on sugarcane in Mississippi and the mosaic disease may be controlled by the use of resistant varieties.

Warning Against Bringing Untreated Sugarcane into the State

The sugarcane mealybug, the West Indian sugarcane fulgorid, and the West Indian sugarcane mite have been found in Florida and southern Georgia. These three insects are not found in Mississippi but are likely to be transferred to uninfested sections through indiscriminate transportation of sugarcane. No cane should be removed from one section to another without first consulting a responsible State or Federal agent. Sugarcane intended for shipment into Mississippi should be properly inspected and, if necessary, treated to destroy any pests likely to be carried on or in it. Also, the presence of any new destructive pest found attacking sugarcane should be reported immediately to the State Entomologist.

State College, Miss.

BULLETIN 396 JANUARY 1944

Cotton Varieties
in the
Hill Section of Mississippi
1943

By
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COTTON VARIETIES IN THE HILL SECTION OF MISSISSIPPI

By J. FRED O'KELLY

Credit for the collection of field data in the variety trials at the hill branch stations must be given Superintendents E. B. Ferris, H. A. York, and T. E. Ashley, in charge at Holly Springs, Raymond, and Poplarville, respectively.

The cotton variety results presented here agree rather closely with results obtained in other years and if given proper consideration along with other related factors, should help the cotton grower choose a satisfactory variety.

The prices used in computing values were, as usual, based on 10 weeks of the Memphis, Tenn., marketing season beginning late in August. For the current season, values were computed for strict low middling and low middling grades in addition to the values for middling grade. The value used for seed in the hill tests was $54.00 per ton.

The outstanding feature of the growing season was the subnormal moisture supply. At State College rainfall for the months of May, June, and July was 1.25, 3.17 and 2.48 inches, respectively, below the long-time averages for those months. This would give a total for those months of a little less than 7 inches compared with a long-time average of over 13 inches. Abnormally high temperatures prevailed much of the time during those

Table 1. Cotton varieties: average results, State College, 1939-1943.

Variety	Pounds lint per acre						Av. acre value (1)	Lint percentage	Staple length, inches	Bolls per pound lint
	1939	1940	1941	1942	1943	Average				
Hi-Bred	428.9	291.2	251.3	574.6	612.3	431.7	75.59	42.4	7/8	159
Deltapine 14 (2)	344.8	244.3	220.7	621.0	585.9	403.3	82.35	40.1	1 1/16	207
Cleveland 54	385.0	277.0	221.9	599.8	494.2	395.6	74.29	36.3	15/16	211
Stoneville 2B	368.7	301.1	205.1	571.7	511.1	391.5	83.47	34.8	1 3/32	203
Coker 100-7 (3)	411.2	302.1	269.8	551.2	423.0	391.5	83.14	37.6	1 1/8	210
Acala 892	373.7	200.0	186.7	625.7	540.9	385.4	75.92	38.2	1	171
Miller	357.3	212.5	210.5	584.4	541.5	381.2	75.12	36.8	1	184
Delfos 531C (4)	325.5	307.3	173.7	515.3	486.5	361.7	87.18	35.0	1 5/32	238
Delfos 651 (5)	317.5	265.5	163.9	520.5	481.6	349.8	81.48	33.6	1 5/32	239
Express 11384 (6)	283.1	236.7	170.0	438.0	316.0	288.8	63.69	32.3	1 1/8	243

(1) Middling grade. (2) Deltapine 12, 1939 and 1940. (3) Coker 100-3, 1939 and 1940; Coker 100-5, 1941 and 1942, (4) Delfos 531-B, 1939. (5) Delfos 6, 1939 and 1940; Delfos 3505, 1941. (6) Express 11383, 1939 and 1940.

Table 2. Cotton varieties: 1943 results, State College.

Variety	Pounds lint per acre	Total acre value—grade			Lint percentage	Staple length, inches	Bolls per pound lint
		Middling	Strict low middling	Low middling			
Hi-Bred	612.3	$139.10	$133.29	$119.20	42.4	7/8	160
Deltapine 14	585.9	152.93	142.39	120.71	41.2	1 3/32	191
Coker 100 Wilt	556.5	145.51	135.77	117.68	37.0	1 1/16	199
Miller	541.5	137.27	129.96	113.99	37.5	1 1/32	179
Acala 892	540.9	134.46	126.88	111.47	38.8	1	167
Stoneville 5A	540.9	145.65	135.91	115.90	36.6	1 3/32	218
Stoneville 2B	511.1	150.36	136.82	113.56	35.2	1 1/8	202
Cleveland 54	494.2	118.11	113.17	101.56	37.5	29/32	205
Delfos 531C	486.5	165.56	146.59	116.43	34.7	1 7/32	242
Delfos 651	481.6	159.08	142.22	115.25	34.7	1 3/16	238
Bobshaw 1	480.4	125.34	116.93	101.32	37.3	1 1/16	218
Bobdel	473.3	148.70	133.32	110.13	34.1	1 5/32	233
Boboak	435.6	135.69	121.53	100.19	35.3	1 5/32	237
Coker 100-7	423.0	137.26	122.45	98.77	37.5	1 3/16	208
Express 11384	316.0	106.79	95.73	78.04	31.6	1 3/16	255

Table 3. Cotton varieties: average results, hill soil, Holly Springs, 1939-1943.

Variety	Pounds lint per acre						Av. acre value (1)	Lint percentage	Staple length, inches	Bolls per pound lint
	1939	1940	1941	1942	1943	Average				
Hi-Bred	643.7	586.9	568.2	735.2	368.6	580.5	94.09	42.4	7/8	172
Stoneville 2B	541.9	609.0	548.3	737.5	320.1	551.4	103.46	35.4	1 3/32	202
Acala 892	527.0	450.5	621.8	659.4	378.5	527.4	95.34	38.1	31/32	170
Deltapine 14 (2)	521.6	448.5	647.6	669.6	348.6	527.2	96.08	39.9	1 1/32	216
Miller	545.7	461.2	580.2	652.9	373.2	522.6	94.18	37.1	31/32	180
Delfos 531C (3)	526.8	509.9	525.2	615.0	293.5	494.1	103.81	34.9	1 5/32	239
Delfos 651 (4)	454.1	520.8	526.3	665.1	298.4	492.9	99.74	35.2	1 1/8	235
Coker 100-7 (5)	520.6	499.0	495.4	621.2	311.7	489.6	93.82	38.1	1 3/32	212
Cleveland 54	435.2	471.2	564.2	621.6	313.0	481.0	85.66	36.2	15/16	220
Express 11384 (6)	407.3	422.4	404.9	513.8	248.1	399.3	81.50	32.8	1 1/8	255

(1) Middling grade. (2) Deltapine 12, 1939 and 1940. (3) Delfos 531B, 1939. (4) Delfos 6, 1939 and 1940; 3506, 1941. (5) Coker 100-3, 1939 and 1940; 100-5, 1941 and 1942. (6) Express 11383, 1939 and 1940.

Table 4. Cotton varieties: 1943 results, hill soil, Holly Springs.

Variety	Pounds lint per acre	Total acre value—grade			Lint percentage	Staple length, inches	Bolls per pound lint
		Middling	Strict low middling	Low middling			
Acala 892	378.5	$91.49	$86.57	$76.35	41.1	31/32	185
Miller	373.2	90.87	86.02	75.94	40.0	31/32	192
Coker 100 Wilt	371.3	93.23	88.21	77.26	38.8	1 1/32	214
Hi-Bred	368.6	81.13	77.63	69.15	44.2	13/16	175
Deltapine 14	348.6	88.01	81.91	70.58	42.2	1 1/16	229
Stoneville 5A	341.6	88.66	82.69	71.58	38.0	1 1/16	233
Bobshaw 1	327.8	82.85	78.42	68.75	37.9	1 1/32	242
Stoneville 2B	320.1	86.07	80.31	68.47	36.8	1 3/32	216
Cleveland 54	313.0	76.73	72.50	64 52	38.5	15/16	228
Coker 100-7	311.7	89.04	80.78	66.60	39.6	1 1/8	227
Delfos 651	298.4	86.50	78.59	65.01	37.3	1 1/8	242
Delfos 531C	293.5	90.68	81.14	66.76	36.5	1 5/32	261
Bobdel	272.7	74.00	69.09	59.00	35.6	1 3/32	255
Boboak	251.0	68.16	63.64	54.35	35.5	1 3/32	260
Express 11384	248.1	78.07	70.01	57.85	33.9	1 5/32	277

Table 5. Cotton varieties: 1943 results, valley soil, Holly Springs.

Variety	Pounds lint per acre	Total acre value—grade			Lint percentage	Staple length, inches	Bolls per pound lint
		Middling	Strict low middling	Low middling			
Deltapine 14	652.5	$172.17	$160.43	$136.28	39.5	1 3/32	217
Stoneville 2B	641.2	186.76	169.77	140.60	36.6	1 1/8	191
Hi-Bred	635.5	147.28	140.92	125.99	41.7	29/32	169
Acala 892	614.9	153.65	145.04	127.52	38.1	1	176
Stoneville 5A	589.7	159.51	148.89	127.07	36.0	1 3/32	229
Miller	589.4	150.08	141.82	125.03	35.7	1	195
Cleveland 54	579.8	145.41	137.87	122.22	36.1	31/32	222
Coker 100 Wilt	578.9	156.00	145.58	124.16	36.5	1 3/32	228
Coker 100-7	570.4	190.80	168.56	133.19	37.5	1 7/32	210
Bobshaw 1	561.0	151.98	141.88	121.13	35.8	1 3/32	218
Delfos 531C	536.9	183.57	162.63	129.35	34.0	1 7/32	262
Delfos 651	527.9	174.85	156.37	126.81	34.3	1 3/16	246
Boboak	473.8	149.77	134.37	111.15	33.3	1 5/32	238
Bobdel	473.5	150.02	134.63	111.43	33.0	1 5/32	238
Express 11384	421.7	153.22	134.66	104.72	31.1	1 1/4	269

months. The moisture deficiency in August was very slight, thus making it possible for much of the fiber to develop well.

At Holly Springs the rainfall deficiency was greater than at the other stations. The total rainfall for May, June, and July was 6.64 inches distributed in numerous showers. A shower of 1.44 inches on May 10 was the only one which made the soil too wet for cultivation. Because of dry and hot weather, yields on the valley soil test were reduced somewhat and those on the hill test were reduced greatly.

A 5-year average table could not be prepared for the valley test because in several recent years poor stands and late germination made the yield figures questionable.

Weather conditions at Raymond handicapped operations somewhat, but final yields in the cotton tests were satisfactory.

Moisture deficiencies at Poplarville handicapped the crop in its early stages and again when fruiting was well under way. The result was slightly lower-than average yields.

It is probable that the hot and dry growing season helped materially in controlling the boll weevil. The cotton in the tests reported here was grown with-

Table 6. Cotton varieties: average results, valley soil, Raymond, 1939-1943.

Variety	Pounds lint per acre						Av. acre value (1)	Lint per-centage	Staple length, inches	Bolls per pound lint
	1939	1940	1941	1942	1943	Average				
Deltapine 14 (2)	777.1	527.2	396.1	731.1	921.1	670.5	142.37	38.1	1 1/8	210
Hi-Bred	797.1	490.1	350.6	561.0	923.4	624.4	105.79	38.8	7/8	170
Stoneville 2B	702.9	529.6	345.9	651.2	786.4	603.2	134.08	33.3	1 1/8	200
Miller	775.8	485.7	369.1	650.5	727.3	601.7	112.01	34.7	1	186
Coker 100-7 (3)	637.4	559.3	371.1	632.4	782.3	596.5	142.96	34.8	1 5/32	205
Cleveland 54	687.4	463.5	385.3	679.3	747.4	592.6	112.47	33.5	31/32	218
Acala 892	684.6	433.8	284.1	621.4	727.6	550.3	102.29	35.9	1	172
Delfos 531C (4)	653.0	475.6	321.0	626.8	671.0	549.5	135.34	32.3	1 3/16	226
Delfos 651 (5)	580.7	434.9	274.8	658.2	658.8	521.5	128.43	31.9	1 5/32	237
Express 11384 (6)	579.1	391.9	242.2	546.4	595.6	471.0	115.47	30.5	1 5/32	251

(1) Middling grade. (2) Deltapine 12, 1939 and 1940. (3) Coker 100-3, 1939 and 1940; 100-5, 1941 and 1942. (4) Delfos 531B, 1939. (5) Delfos 6, 1939 and 1940; 3506, 1941. (6) Express 11383, 1939 and 1940.

Table 7. Cotton varieties: 1943 results, valley soil, Raymond.

Variety	Pounds lint per acre	Total acre value—grade			Lint per-centage	Staple length, inches	Bolls per pound lint
		Middling	Strict low middling	Low middling			
Hi-Bred	923.4	$210.58	$201.81	$180.57	39.1	27/32	151
Deltapine 14	921.1	265.28	240.87	198.96	38.3	1 1/8	204
Bobshaw 1	826.3	219.32	204.86	178.00	35.1	1 1/16	193
Coker 100 Wilt	791.8	235.47	214.48	178.46	33.8	1 1/8	198
Stoneville 2B	786.4	234.80	213.97	178.18	33.3	1 1/8	181
Coker 100-7	782.3	265.53	235.02	186.51	35.1	1 7/32	192
Stoneville 5A	765.2	210.19	196.41	168.10	34.1	1 3/32	204
Cleveland 54	747.4	191.24	181.53	161.35	33.8	31/32	198
Bobdel	732.6	246.99	221.35	180.32	31.9	1 3/16	213
Acala 892	727.6	183.63	173.44	152.70	36.8	1	150
Miller	727.3	186.77	176.59	155.86	34.7	1	182
Delfos 531C	671.0	224.49	201.01	163.43	32.9	1 3/16	212
Boboak	666.3	215.56	193.91	161.26	30.5	1 5/32	225
Delfos 651	658.8	220.91	197.86	160.96	32.6	1 3/16	240
Express 11384	595.6	207.89	184.66	147.73	31.2	1 7/32	240

Table 8. Cotton varieties: average results, hill soil, Raymond, 1939-1943.

Variety	Pounds lint per acre						Av. acre value (1)	Lint percentage	Staple length, inches	Bolls per pound lint
	1939	1940	1941	1942	1943	Average				
Hi-Bred	590.6	583.2	479.1	710.4	633.8	599.4	96.94	41.5	13/16	175
Stoneville 2B	483.2	578.0	541.8	758.0	550.7	582.3	114.20	35.8	1 1/16	212
Deltapine 14 (2)	522.2	551.8	494.0	761.9	567.9	579.6	107.53	39.7	1 1/32	226
Coker 100-7 (3)	525.9	512.7	487.7	768.8	563.4	571.7	117.72	38.1	1 3/32	216
Cleveland 54	492.8	535.0	511.1	713.2	590.4	568.5	102.97	35.9	29/32	218
Miller	452.6	448.3	522.5	693.7	550.6	533.5	102.11	36.8	15/16	191
Acala 892	500.2	381.2	461.9	639.5	560.0	508.6	94.56	37.3	15/16	187
Delfos 531C (4)	415.4	474.3	454.6	702.6	483.0	506.0	112.01	35.0	1 1/8	243
Delfos 651 (5)	397.9	484.9	416.2	683.3	498.4	496.1	107.18	34.1	1 3/32	250
Express 11384 (6)	416.0	421.8	408.3	599.4	420.0	453.1	99.00	32.9	1 3/32	242

(1) Middling grade. (2) Deltapine 12, 1939 and 1940. (3) Coker 100-3, 1939 and 1940; 100-5, 1941 and 1942. (4) Delfos 531B, 1939. (5) Delfos 6, 1939 and 1940; 3506, 1941. (6) Express 11383, 1939 and 1940.

Table 9. Cotton varieties: 1943 results, hill soil, Raymond.

Variety	Pounds lint per acre	Total acre value—grade			Lint percentage	Staple length, inches	Bolls per pound lint
		Middling	Strict low middling	Low middling			
Hi-Bred	633.8	$141.72	$135.70	$121.12	41.8	13/16	172
Bobshaw 1	607.1	152.97	144.47	127.17	37.0	1	217
Coker 100 Wilt	603.5	151.13	142.68	125.48	37.8	1	198
Cleveland 54	590.4	142.27	136.36	122.49	36.5	29/32	222
Miller	550.6	136.23	129.07	114.21	37.8	31/32	184
Deltapine 14	567.9	144.54	134.60	116.15	40.9	1 1/16	215
Coker 100-7	563.4	161.64	146.71	121.08	38.9	1 1/8	204
Acala 892	560.0	137.48	129.92	115.64	38.3	15/16	184
Stoneville 2B	550.7	144.88	135.25	117.35	36.2	1 1/16	185
Stoneville 5A	543.8	136.49	128.88	113.38	37.5	1	211
Delfos 651	498.4	155.47	139.27	114.85	35.1	1 5/32	238
Boboak	484.8	144.06	131.22	109.16	33.9	1 1/8	231
Delfos 531C	483.0	150.67	134.97	111.30	35.1	1 5/32	236
Bobdel	464.4	138.22	125.91	104.78	33.7	1 1/8	240
Express 11384	420.0	133.71	120.06	99.48	32.4	1 5/32	250

out the use of calcium arsenate. In seasons with normal to heavy rainfall the judicious use of calcium arsenate will often improve yields materially, especially if enough nicotine is used to control plant lice. Instructions concerning the use of calcium arsenate in boll weevil control can be supplied by the Department of Entomology, State College, Mississippi.

The reader is urged to depend most on average results where this is possible but the results of the current year will be of interest especially in regard to new strains which have not been in the trials long enough to be included in the averages.

Computing values on the basis of the three grades, middling, strict low middling, and low middling has been done primarily to show how the selling price of various staple lengths may vary as the grade is reduced. These values emphasize the need for the prompt harvesting of cotton, especially staple cotton, if premium prices for such cotton are to be obtained. Varieties vary somewhat in their resistance to weather damage, but unfortunately a method for showing this as a part of a variety test has not been developed.

Seed supplies for planting the tests were obtained from the originators in all cases.

Table 10. Cotton varieties average results, Poplarville, 1940-1943.

Variety	Pounds lint per acre					Av. acre value (1)	Lint percentage	Staple length, inches	Bolls per pound lint
	1940	1941	1942	1943	Average				
Hi-Bred	524.2	511.6	278.0	345.3	414.8	71.01	43.2	27/32	189
Cleveland 54	498.9	489.7	290.0	363.8	410.6	75.37	37.9	7/8	232
Stoneville 2B	533.9	469.2	270.3	261.3	383.7	74.93	36.2	1 1/16	210
Bobshaw 1	406.7	457.5	349.7	280.8	373.7	72.30	37.9	1	245
Miller	444.1	437.6	341.2	229.1	363.0	67.65	38.6	15/16	200
Coker 100-7 (2)	398.9	486.8	274.6	204.1	341.1	70.43	37.9	1 3/32	218
Deltapine 14 (3)	414.2	431.5	259.7	252.0	339.3	64.06	41.6	1 1/32	228
Acala 892	394.7	379.7	264.7	202.4	310.4	57.07	38.3	15/16	200
Delfos 651 (4)	367.0	369.1	154.7	268.7	289.9	62.91	35.1	1 1/8	256
Delfos 531C	363.3	382.8	178.5	165.1	272.4	60.17	35.8	1 5/32	271
Express 11384 (5)	313.2	360.5	155.0	200.6	257.3	55.16	33.8	1 3/32	265

(1) Middling grade. (2) Coker 100-3, 1940; Coker 100-5, 1941 and 1942. (3) Deltapine 12, 1940. (4) Delfos 6, 1940; 3506, 1941. (5) Express 11383, 1940.

Table 11. Cotton varieties: 1943 results, Poplarville.

Variety	Pounds lint per acre	Total acre value—grade			Lint percentage	Staple length, inches	Bolls per pound lint
		Middling	Strict low middling	Low middling			
Cleveland 54	363.8	$85.13	$81.68	$73.31	38.3	7/8	197
Hi-Bred	345.3	76.64	73.36	65.41	42.9	13/16	176
Coker 100 Wilt	290.3	73.48	69.56	60.99	37.7	1 1/32	215
Bobshaw 1	280.8	70.10	66.17	58.17	38.2	1	240
Delfos 651	268.7	83.94	75.21	62.04	34.9	1 5/32	238
Stoneville 2B	261.3	68.42	63.85	55.36	36.8	1 1/16	208
Stoneville 5A	258.7	65.59	62.10	54.46	37.5	1 1/32	231
Boboak	253.7	69.18	64.61	55.22	35.0	1 3/32	241
Deltapine 14	252.0	63.71	59.30	51.11	42.0	1 1/16	205
Miller	229.1	55.98	53.00	46.81	39.5	31/32	173
Coker 100-7	204.1	62.54	55.91	45.91	37.8	1 5/32	211
Acala 892	202.4	47.71	45.68	40.93	39.3	29/32	185
Express 11384	200.6	63.07	56.55	46.72	34.0	1 5/32	247
Delfos 531C	165.1	54.25	48.47	39.22	35.5	1 3/16	302
Bobdel	107.1	31.53	28.69	23.81	35.1	1 1/8	316

Table 12. Cotton varieties, six locations, 1943.

Variety	Pounds lint per acre						Averages		
	Holly Springs		State College	Raymond		Poplarville	Lint percentage	Staple inches	Bolls per lb. lint
	Hill	Valley		Hill	Valley				
Hi-Bred	368.6	635.5	612.3	633.8	923.4	345.3	42.0	27/32	167
Deltapine 14	348.6	652.5	585.9	567.9	921.1	252.0	40.7	1 3/32	210
Coker 100 Wilt	311.7	578.9	556.5	603.5	791.8	290.3	37.1	1 1/16	211
Cleveland 54	313.0	579.8	494.2	590.4	747.4	363.8	36.8	15/16	212
Bobshaw 1	327.8	561.0	480.4	607.1	826.3	280.8	36.9	1 1/32	221
Stoneville 2B	320.1	641.2	511.1	550.7	786.4	261.3	35.8	1 3/32	197
Stoneville 5A	341.6	589.7	540.9	543.8	765.2	258.7	36.6	1 1/16	221
Acala 892	378.5	614.9	540.9	560.0	727.6	202.4	38.7	31/32	174
Miller	373.2	589.4	541.5	550.6	727.3	229.1	37.5	1	184
Coker 100-7	311.7	570.4	423.0	563.4	782.3	204.1	37.7	1 5/32	209
Delfos 651	251.0	527.9	481.6	498.4	658.8	268.7	34.5	1 5/32	243
Delfos 531C	293.5	536.9	486.5	483.0	671.0	165.1	34.8	1 3/16	252
Boboak	251.0	473.8	435.6	484.8	666.3	253.7	33.9	1 1/8	239
Bobdel	272.7	473.5	473.3	464.4	732.6	107.1	33.9	1 1/8	249
Express 11384	248.1	421.7	316.0	420.0	595.6	200.6	32.4	1 3/16	256

Seed Sources, 1943

Acala 892—Cotton Branch Station, Marianna, Arkansas.

Bobdel (Bobshaw 16)—Bobshaw Seed Company, Heathman, Mississippi.

Boboak (Bobshaw 12)—Bobshaw Seed Company, Heathman, Mississippi.

Bobshaw 1—Bobshaw Seed Company, Heathman, Mississippi.

Cleveland 54—Mississippi Experiment Station, State College, Mississippi.

Coker 100-7 and 100 Wilt—Coker Pedigreed Seed Company, Hartsville, S. C.

Delfos 531C—Stoneville Pedigreed Seed Company, Stoneville, Mississippi.

Delfos 651—Delta Experiment Station, Stoneville, Mississippi.

Deltapine 14—Delta and Pine Land Company, Scott, Mississippi.

Express 11384—Delta Experiment Station, Stoneville, Mississippi.

Hi-Bred—B. F. Summerour, Norcross, Georgia.

Miller—Mississippi Experiment Station, State College, Mississippi.

Stoneville 2B and 5A—Stoneville Pedigreed Seed Company, Stoneville, Mississippi.

The list of seed sources is given for the interest of those who may not be familiar with the originators of the leading varieties and strains of cotton. In many cases the supplies of the originator are already exhausted and late purchasers will be obliged to fill their needs from producers of certified seed or from other dependable sources.

BULLETIN 397 JANUARY 1944

Fertilizers
for
Cabbage, Peas, and Tomatoes

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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Summary and Recommendations

A study was made in 1939, 1940, 1941, and 1942 of the effect of varying nitrogen, phosphorus, and potash, and the rates of applying 4-8-4 with cabbage, peas, and tomatoes, in the Copiah County trucking area.

In presenting this information consideration is given to certain factors such as weather conditions, estimated production costs, and profits, as well as the fertilizers which are on the market for the 1943-44 season.

The results show that in varying the amount of nitrogen, phosphorus, or potash in cabbage fertilizer, greater increases came from nitrogen. As the nitrogen was increased the yields and profits were correspondingly increased. Increasing the amount of phosphorus up to 12 percent also gave increased yields and profits. As the potash was varied little difference in yields was obtained.

It is concluded that in order for truck growers in the Copiah County area to realize the most from cabbage fertilizers, approximately 60 pounds of nitrogen (N), 100 pounds of phosphorus (P_2O_5), and 40 pounds of potash (K_2O) per acre should be applied to the soil before setting the plants in the field, and 32 pounds of actual nitrogen should be applied as a side dressing as soon as the danger of severe cold weather has passed. The recommended plant food is supplied by applying 1000 pounds of 6-8-4 to the acre before setting, plus side dressing with 100 pounds of ammonium nitrate or its equivalent.

These results show that for the most profitable production of peas, nitrogen and phosphorus are important, and that potash above 40 pounds to the acre had little influence on yield.

It is recommended to growers of peas that the soil be supplied with 40 to 50 pounds of nitrogen (N), 100 pounds of phosphorus (P_2O_5), and 40 pounds of potash (K_2O) per acre before planting, plus about 16 pounds of actual nitrogen 6 weeks later. This amount of plant food is supplied by 1000 pounds of 5-10-5 before planting and 100 pounds of nitrate of soda, or its equivalent, applied as a side dressing.

Varying each element in tomato fertilizer while the other two remain constant gave results which indicate that all three nutrients are needed in large quantities. These results also show that high applications of nitrogen do not increase the percentage of culls, or seriously affect the storage qualities of tomatoes.

It is recommended to tomato growers that the soil be supplied with 60 pounds of nitrogen (N), 120 pounds of phosphorus (P_2O_5), and 60 to 80 pounds of potash (K_2O) before the plants are set in the field. This is supplied by approximately 1200 pounds of 5-10-5, plus a side dressing of 32 pounds of actual nitrogen supplied by 100 pounds of ammonium nitrate or its equivalent 6 weeks after setting.

Studies of the residual effects of fertilizer under cabbage, peas, and tomatoes upon corn yields showed that nitrogen is the most important element. They also show that tomato land should be planted to a summer cover crop instead of corn, because the yield obtained from corn following tomatoes is not great enough to pay for the cost of producing the crop.

Fertilizers
for
Cabbage, Peas, and Tomatoes

By E. L. MOORE and J. A. CAMPBELL*
Truck Crops Branch Experiment Station, Crystal Springs

The production of vegetables in Mississippi to be shipped north for early market, as well as those produced for home use, is an agricultural enterprise of considerable importance.

Vegetables have long been recognized as an important food crop because they contain certain food elements which are difficult to obtain from other sources. With the nation demanding more and more foods for our armed forces, lend-lease, and the civilian population, the importance of vegetables has been stimulated. The new methods of processing foods by dehydration and the increased interest in canning has attached even more importance to the vegetable producing industry.

Commercial Truck Crops in Mississippi

There are four recognized commercial vegetable producing areas in the State. Cucumbers for pickles and watermelons for shipping are produced in the Stone County area. The watermelon producing area extends as far northwest as Covington and Smith Counties. Vegetables are grown commercially for canning in the Marion, Pike, and Jones County areas. The growing of sweetpotatoes for starch manufacturing is a new and increasing enterprise in the Laurel area. Copiah and adjoining counties, long noted for the production of tomatoes, is the most important vegetable area. Although small quantities of certain root crops are grown in the Copiah County area, it is largely devoted to the production of cabbage, snap beans, garden peas, peppers, and tomatoes.

The Copiah County area is one of the oldest commercial vegetable areas in the South. Interest was initiated back in 1875. At present, approximately 20,000 acres of truck crops are grown annually in this area. Vegetable growers are interested in producing high yields of marketable grades, and in having their products ready for the early market which demands premium prices. A delay of three or four days in harvesting may result in a reduced market price of 30 to 40 percent, which makes the early production more important.

Certain conditions in this area are favorable to large production of high quality vegetables, but there are some which present problems of great importance. For this reason the Mississippi Legislature appropriated funds, and an experimental farm was established during the fall of 1938 to study some of the controllable problems. Experimental work has been undertaken to investigate problems of propagation, varieties, fertilization, cultivation, and insects and diseases attacking truck crops grown in this area.

Fertilizer Experiments Described

Because of the large expenditures on commercial fertilizer for the production of truck crops in the Copiah County area, one of the first problems attacked was that of the application of commercial fertilizers.

It is the purpose of this bulletin to report only that part of this work which was designed to study various fertilizer mixtures and different rates of 4-8-4, for cabbage, peas, and tomatoes.

The soil selected for these studies is

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*The experiments were planned and the data for 1939, 1940, and 1941 were obtained by Mr. Campbell, who is on military leave. The data for 1942 were obtained and the manuscript prepared by Mr. Moore.

classified as Grenada silt loam. It has grown various truck crops receiving approximately uniform fertilizer treatments for more than 30 years, and since large applications of commercial fertilizer have been made, the soil had a comparatively high content of the various plant nutrients at the beginning of the experiments.

The experiments were conducted in 1939, 1940, 1941, and 1942. In each instance the plots were located on the same site each year, and received the same fertilizer treatments as in the previous year.

Six rates—500, 1000, 1500, 2000, 2500, and 3000 pounds of 4-8-4 per acre, and eleven fertilizer formulas—0-8-4, 4-8-4, 6-8-4, 8-8-4, 4-0-4, 4-4-4, 4-12-4, 4-16-4, 4-8-0, 4-8-8, and 4-8-12, each applied at the rate of 1000 pounds per acre, were tested. Each plot in all experiments received 200 pounds of nitrate of soda about six weeks after the crop was planted in the field, except that only 100 pounds per acre were applied to peas. Each treatment was repeated five times. The fertilizers tested were home mixed of nitrate of soda (16 percent N), superhosphate (20 percent P_2O_5), and muriate of potash (50 percent K_2O). Dolomitic limestone was used as a filler.

Cabbage, garden peas, and tomatoes were used in the tests, and were so rotated that each crop occupied the land once in 3 years. In 1939 and 1940 the Golden Acre variety of cabbage was used, but in 1941 and 1942 Detroit Resistant was used. World Record peas were used throughout the experiments. The Gulf State Market tomato variety was used in 1939 and 1940, but Rutgers was used in 1941 and 1942. Corn was planted following the truck crops, which is a common practice of truck growers, without applying additional fertilizer except a top-dressing of nitrogen. The fertilizer was applied about four weeks prior to the setting of cabbage and planting of peas and about ten days before tomatoes were set in the field. During each year the crops were planted on or as near the same date as weather conditions would permit. The cabbage were set in the field January 28, 1939; February 8, 1940; January 21, 1941; and January 20, 1942. Peas were planted January 28, 1939; February 20, 1940; January 21, 1941; and January 19, 1942. Tomatoes were set in the field on March 27, 1939, April 4, 1940, April 5, 1941, and April 1, 1942.

Factors Influencing Yield and Profits

Yields of cabbage, peas, and tomatoes are affected by several factors, some of which are controllable and some of which are not. Among the controllable factors are fertilizers, varieties, seeding and transplanting dates, spacing of the plants in the row, and to some extent the labor. As any or all of these factors vary the cost of production varies, and in most instances the yield varies. For instance, any variation in the analysis of fertilizer used results in a variation in costs. With peas and cabbage, a variation in the proportions of nitrogen and phosphorus in the fertilizer formula means a variation in yield. The variation in rates of applying fertilizer also results in a variation in costs and yields. The use of better adapted varieties which produce higher yields causes an increase in harvesting and total expense. The additional cost for harvesting, however, may be more than offset by the profits obtained due to higher yields. The same is true with planting dates. If the crop is planted late the harvest date is late also, which means the grower will not share in the higher early-market prices. Labor, a precious item in truck growing, plays quite a part in the costs of production. Any variation in these basic costs results in a variation of profits received. Each of these items varies on different farms, as well as from year to year, but it is believed that an estimate of the average

Table 1. Cost of producing 1 acre of cabbage, peas, and tomatoes with different fertilizer treatments.[1]

Fertilizer treatment	Cabbage				Peas				Tomatoes			
	Fertilizer[2] and applications	Other production costs	Harvesting and hauling	Total for cabbage	Fertilizer and applications	Other production costs	Harvesting and hauling	Total for peas	Fertilizer and applications	Other production costs	Harvesting and hauling	Total for Tomatoes
Varying amounts of nitrogen, phosphorus, and potash in 1000 pounds of fertilizer to the acre.												
0-8-4	$16.18	$35.00	$ 6.85	$58.03	$14.18	$29.25	$36.54	$ 79.97	$16.18	$40.00	$ 9.64	$65.64
4-8-4	20.68	35.00	9.27	64.95	18.68	29.25	64.68	112.61	20.68	40.00	13.87	74.55
6-8-4	22.93	35.00	10.91	68.84	20.93	29.25	68.70	118.88	22.93	40.00	14.82	77.21
8-8-4	25.18	35.00	11.62	71.80	23.18	29.25	70.86	123.29	25.18	40.00	13.88	79.06
4-0-4	16.68	35.00	9.58	61.26	14.68	29.25	45.84	89.77	16.68	40.00	10.33	67.01
4-4-4	18.68	35.00	9.58	63.26	16.68	29.25	65.04	110.97	18.68	40.00	13.20	71.88
4-12-4	22.68	35.00	10.47	68.15	20.68	29.25	68.70	118.63	22.68	40.00	14.41	77.09
4-16-4	24.94	35.00	10.37	70.31	22.94	29.25	69.24	121.43	24.94	40.00	14.81	79.75
4-8-0	19.00	35.00	9.32	63.32	17.00	29.25	66.42	112.67	19.00	40.00	13.88	72.88
4-8-8	22.36	35.00	9.99	67.35	20.36	29.25	67.14	116.75	22.36	40.00	14.82	77.18
4-8-12	24.04	35.00	9.04	68.08	22.04	29.25	66.12	117.41	24.04	40.00	14.82	78.86
Varying rates of 4-8-4.												
500	$13.34	$35.00	$ 7.56	$55.90	$11.34	$29.25	$60.00	$101.19	$13.34	$40.00	$ 9.28	$62.62
1000	20.68	35.00	8.96	64.64	18.68	29.25	69.06	116.99	20.68	40.00	11.07	71.75
1500	28.02	35.00	9.80	72.82	26.02	29.25	74.88	130.15	28.02	40.00	12.18	80.20
2000	35.36	35.00	10.36	80.72	33.36	29.25	73.68	136.29	35.36	40.00	13.46	88.82
2500	42.70	35.00	11.06	88.76	40.70	29.25	74.82	144.77	42.70	40.00	13.28	95.98
3000	50.04	35.00	11.20	96.24	48.04	29.25	76.38	153.67	50.04	40.00	12.45	102.49

[1] Nitrate of soda at $40.00 per ton, phosphorus at $23.97 per ton, potash at $46.47 per ton, filler at $4.50 per ton.

[2] Cost of fertilizer and application includes side dressing with 200 pounds nitrate of soda for cabbage and tomatoes, 100 pounds for peas, and $1.00 each for applying the fertilizer and side dressing.

costs involved will be of value to the reader in interpreting the yield data presented.

Fertilizer Costs

In table 1 is shown the cost of producing one acre of cabbage, tomatoes, and peas. The prices of the ingredients are based on quotations obtained from local dealers in Crystal Springs and Hazlehurst. Nitrate of soda is considered at $40.00 per ton, superphosphate at $23.97 per ton, and muriate of potash at $46.47 per ton. The filler is considered at $4.50 per ton, which is the price the Experiment Station paid in 1942. The cost of applying the fertilizer is shown as a part of fertilizer cost.

Other Production Costs

Other production costs include an estimate on the cost of labor for preparing the land, cultivation, and other practices which vary with the different crops.

Cabbage. The fixed cost of $35.00 for producing cabbage includes the cost of the plants, preparing the land, setting the plants, insect control, and the cultivation of the crop. This cost will vary on different farms, but with the average farm under the present cost of labor this fixed cost is fairly representative. The cost of harvesting and hauling cabbage to town is estimated at $1.40 per ton.

Peas. The estimated fixed cost of $29.25 for producing an acre of peas includes 1943 prices paid for seed, preparing the land, planting, cultivating, twine, staking, and stringing. The harvesting and hauling costs include the 1943 prices for hampers, picking, and hauling to town.

Tomatoes. With tomatoes the estimated fixed cost of $40.00 for producing an acre includes the cost of plants at $2.00 per thousand, preparation of land, setting the plants, cultivation, insect control, pruning, staking, and tying. Cost of harvesting and hauling is calculated at 8 cents per field box. The cost of labor is calculated at $2.00 per day, and the cost per mule is figured at 50 cents per day. It is estimated in cultivating truck crops that one man and one mule can plow eight furrows to an acre in a day.

This schedule of costs does not include the value of the land, buildings, plow tools, and equipment, or any other overhead expense.

Weather

Since the production of vegetables is greatly influenced by weather conditions, especially the amount and frequency of rains, data are presented from the U. S. Weather Bureau. The total rainfall during March, April, May, June, and July, the most important growing months in the area, for each of the 4 years is presented in table 2. Because the frequency of rain is as important as the total amount, the date on which a rain of one-fourth inch or more occurred is presented in table 3.

In 1939 the rainfall for each month, except April and July, was similar and was considered very good. Rainfall was less in April than in any of the other months. On March 30 a 3-inch rain came which was helpful to the crops in

Table 2. Total inches of rainfall for vegetable growing season during 1939, 1940, 1941, 1942, and the past 54-year average, Crystal Springs, Mississippi.*/

Year	March	April	May	June	July	Total
1939	6.98	3.67	6.44	6.45	4.96	28.5
1940	4.27	9.74	0.97	4.23	19.58	38.79
1941	5.22	6.84	2.57	1.62	6.26	22.50
1942	5.26	2.26	4.91	3.21	3.32	18.96
Ave. 1888 to 1942	5.67	4.95	4.41	4.56	5.83	

*/From U. S. Weather Bureau data, Crystal Springs.

Table 3. Frequency of rainfall during vegetable growing seasons of 1939, 1940, 1941, and 1942, Crystal Springs.*/

1939		Inches	1940		Inches	1941		Inches	1942		Inches
Mar.	2	.70	Mar.	13	1.45	Mar.	7	2.15	Mar.	2	.73
	6	.72		28	1.15		16	.51		8	.53
	26	1.67		30	1 63		21	1.32		13	.30
	27	.62	April	4	.4		27	.30		21	2.00
	30	3.00		5	.63		31	.57		26	.98
April	4	.70		7	.82	April	1	.45	April	9	1.43
	6	.33		12	2.00		3	.71		17	.63
	12	.73		18	.38		8	.41	May	12	.31
	17	1.06		19	1.11		20	.61		14	.74
	25	.64		29	1.08		21	1.54		15	2.38
May	7	.34		30	3.20		22	.41		20	1.05
	8	.64	May	1	.22		24	2.64		23	.25
	18	.77		14	.25	May	5	.55	June	5 & 6	.44
	19	1.23		23	.31		6	.34		8	.21
	25	.47	June	7	.48		18	.50		9	.59
	26	2.57		9	.33		26	.33		10	.63
June	2	1.95		16	.43		30	.48		20	.48
	3	1.30		24	.57	June	1	.30		21	.24
	4	.54		25	.41		12	.46	July	1	.51
	16	.55		29	1.12		16	.29		6	.43
	19	.28	July	3	3.58	July	1	1.09		15	.69
	29	1.27		6	6.85		2	.67		19	.99
July	2	.76		7	2.57		4	1.34		21	.40
	10	2.00		12	2.72		11	.58		—	—
	11	.40		13	.71		14	.56		—	—
	23	.27		15	.35		17	.30		—	—
	24	.55		16	1.03		19	.33		—	—
	25	.26		30	.41		23	.25		—	—
	28	.47		—	—		25	.67		—	—
	—	—		—	—		26	.31		—	—

*/From U. S. Weather Bureau data, Crystal Springs.

April. During June there was probably an excess to the extent that it interfered with the harvesting of tomatoes.

Yields were low in 1940. The total rainfall for that season was 10 inches greater than in any of the other years, but the distribution was unfavorable. In March rains were 2 weeks apart and drought was experienced. Sufficient moisture was supplied by rains in April. Less than one inch of rain fell during May. Dry weather in May undoubtedly accounts for some of the low yields obtained in the experiments. Rainfall was favorable in June, and in July the total rainfall was almost 20 inches.

Rainfall in the 1941 season approached the ideal, except for dry periods during May and June.

The total rainfall in 1942 was, in general, somewhat less than desired, but the dates on which rains of importance came were so distributed that the crops did not suffer for moisture at any time to any great extent.

Results of Fertilizer Experiments

Effect of Varying Nitrogen, Phosphorus, and Potash

The results obtained from varying the nitrogen, phosphorus, and potash in a 1000-pound application of fertilizer for the three crops in the 4 years are presented in table 4. This table also shows the crop rotation during the 4-year period. Thus, in 1939 cabbage were in field 1, peas in field 2, and tomatoes in field 3. In 1940 peas were in field 1, tomatoes in 2, and cabbage in 3. In 1941 tomatoes were in field 1, cabbage in 2, and peas in 3. In 1942 the crops occupied the same land as they did in 1939.

Table 4. Effect of varying nitrogen, phosphorus, and potash in a 1000-pound fertilizer mixture on the yield of marketable cabbage, peas, and tomatoes during 4 years, 1939 to 1942.

Treatments[1]	Cabbage—tons per acre Fields					Peas—hampers per acre[2] Fields					Tomatoes—field boxes per acre[3] Fields				
1000 lbs. per acre of:	1	3	2	1	4-year average	2	1	3	2	4-year average	3	2	1	3	4-year average
	Years					Years					Years				
	1939	1940	1941	1942		1939	1940	1941	1942		1939	1940	1941	1942	
0-8-4	4.36	5.42	2.56	7.22	4.89	24.6	87.4	74.1	91.1	69.3	60.9	94.2	145.4	172.2	118.2
4-8-4	5.27	6.83	5.34	9.06	6.62	85.4	95.7	142.5	107.6	107.8	108.2	70.8	244.6	270.0	173.4
6-8-4	6.15	9.22	6.94	8.86	7.79	87.6	108.2	155.8	106.5	114.5	126.0	77.2	249.8	288.3	185.3
8-8-4	6.68	9.18	8.06	9.26	8.30	96.4	112.4	150.6	112.9	118.1	119.1	72.8	222.7	279.3	173.5
4-0-4	6.03	7.31	5.67	8.34	6.84	43.9	93.6	79.4	88.5	76.4	78.8	92.4	171.5	173.7	129.1
4-4-4	5.57	6.81	5.95	9.02	6.84	80.8	113.2	134.8	104.6	108.4	92.7	73.8	238.5	255.1	165.0
4-12-4	6.48	8.62	6.22	8.62	7.48	86.0	107.2	155.0	109.7	114.5	116.4	85.0	207.7	311.2	180.1
4-16-4	6.30	7.96	5.81	9.58	7.41	82.1	114.1	146.6	118.9	115.4	107.1	81.6	245.2	306.6	185.1
4-8-0	5.24	7.27	5.57	8.54	6.66	76.3	117.2	143.1	106.3	110.7	115.8	73.2	229.4	275.6	173.5
4-8-8	5.64	7.26	5.84	9.80	7.14	85.6	110.9	145.4	105.6	111.9	110.3	86.6	246.5	297.6	185.2
4-8-12	5.73	7.68	5.96	9.32	7.17	67.0	109.0	150.6	114.2	110.2	108.3	97.8	249.4	285.1	185.2

[1] All plots received a side dressing with 200 pounds of 16 percent nitrate of soda to the acre except peas which received 100 pounds.

[2] Hamper of peas weighs 28 pounds.

[3] Field box of tomatoes weighs 70 pounds.

Table 5. Effect of varying the rates of 4-8-4 from 500 to 3000 pounds per acre upon the yield of marketable cabbage, peas, and tomatoes, during 4 years: 1939-1942.

Treatments[1]	Cabbage—tons per acre Fields					Peas—hampers per acre[2] Fields					Tomatoes—field boxes per acre[3] Fields				
Amount of 4-8-4 per acre	2	1	3	2	4-year average	1	3	2	1	4-year average	3	2	1	3	4-year average
	Years					Years					Years				
	1939	1940	1941	1942		1939	1940	1941	1942		1939	1940	1941	1942	
3000	7.0	7.8	7.0	10.2	8.0	148.4	89.6	147.5	123.8	127.3	52.6	71.7	177.9	320.1	155.6
2500	6.9	7.3	7.7	9.5	7.9	157.4	85.2	135.3	120.8	124.7	68.4	73.5	169.5	352.5	166.0
2000	6.8	6.9	7.0	8.8	7.4	137.6	87.1	142.0	124.6	122.8	66.0	74.2	190.5	342.6	168.3
1500	7.1	6.0	6.2	8.5	7.0	144.4	85.3	156.0	113.5	124.8	66.7	83.4	146.8	311.7	152.2
1000	6.4	5.8	5.7	8.0	6.4	120.5	84.0	144.0	112.0	115.1	55.3	82.4	124.7	291.4	138.4
500	5.9	5.1	3.9	6.7	5.4	87.2	73.6	139.0	104.4	101.0	77.1	57.1	88.7	240.9	116.0

[1] All plots received a side dressing with 200 pounds of 16 percent nitrate of soda to the acre except peas which received 100 pounds.

[2] Hamper of peas weighs 28 pounds.

[3] Field box of tomatoes weighs 70 pounds.

In general, increased yields were obtained with all three crops when the levels of nitrogen and phosphorus were increased in the fertilizer. Response to nitrogen was obtained with all crops during each year. Cabbage showed response to high levels of phosphorus in 1941 and 1942 but did not show any response in 1939 and 1940. Increased yields were obtained with peas and tomatoes from plots receiving 4 percent phosphorus as compared to those from plots receiving no phosphorus during each of the 4 years, and by 1941 higher levels of phosphorus gave some response. Increased yields were not obtained from increasing the levels of potash on either of the crops until 1941, and then slight differences were obtained with tomatoes only.

These results indicate that excessive quantities of 4-8-4 were applied during preceeding years, and while the nitrogen either leached out or was used by the crop, the phosphorus and potash accumulated in the soil in sufficient quantities to supply the needs of the plants for the first two or three years of these experiments.

The variation in yields during different years with each crop receiving identical fertilizer treatment can be attributed to weather conditions, improved cultural practices, and a change in varieties. The change in varieties of cabbage and tomatoes in 1941 probably accounts for the greater part of the increase in yield in 1941 and 1942 over 1939 and 1940.

Varying Rate of 4-8-4

The data presented in table 5 show, in general, that yields were increased with peas and cabbage by increasing the rates of 4-8-4 up to 3000 pounds. With tomatoes, an increase in yields was not obtained by applying more than 2000 pounds of 4-8-4 to the acre. With each crop it is noted that the increase in yields began to diminish after the rates were raised above 1500 pounds. The data in table 5 might be misleading unless they are studied along with the data in table 4.

Experiments With Cabbage

Varying the Quantity of Nitrogen

Table 6 shows the 4-year yield, the 1943 costs of production, and the estimated profits under these conditions from

Table 6. Effect of varying nitrogen, phosphorus, and potash in a 1000-pound fertilizer mixture on average yields, costs, and profits to the acre with cabbage.

Fertilizer[1] treatment	Yield, 4 yr. av. (tons)	Production[2] costs	Profits[3]
	Varying nitrogen		
0-8-4	4.89	$65.64	$ 81.06
4-8-4	6.62	74.55	124.05
6-8-4	7.79	77.75	155.95
8-8-4	8.30	79.06	169.94
	Varying phosphorus		
4-0-4	6.84	67.01	138.19
4-4-4	6.84	71.88	133.32
4-8-4	6.62	74.55	124.05
4-12-4	7.48	77.09	147.31
4-16-4	7.41	79.75	142.55
	Varying potash		
4-8-0	6.66	72.88	126.92
4-8-4	6.62	74.55	124.05
4-8-8	7.14	77.18	137.02
4-8-12	7.17	78.86	136.24

[1] All plots in this experiment received a side dressing with 200 pounds of nitrate of soda to the acre.

[2] Production costs based on 1943 prices.

[3] Profits based on cabbage selling at $30.00 per ton.

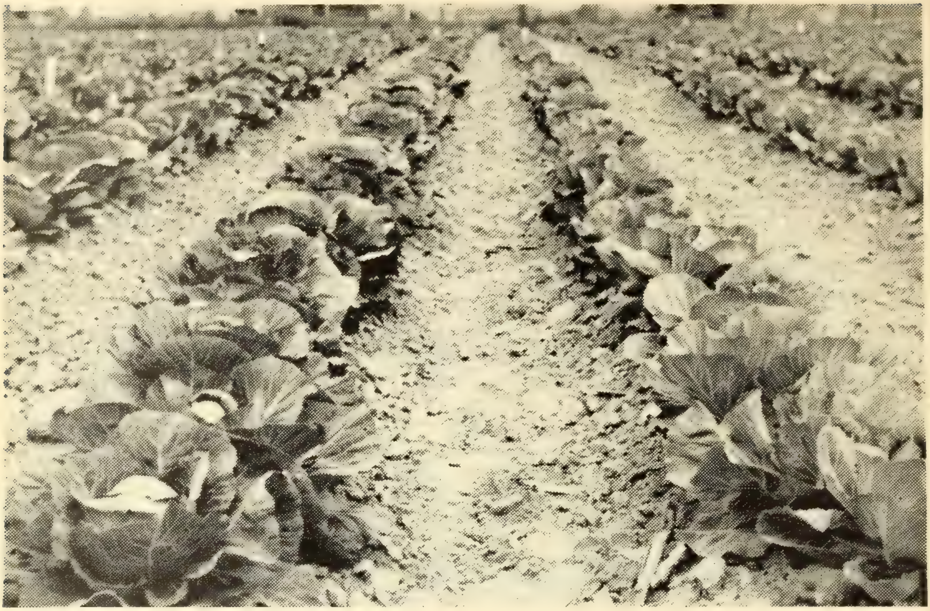

Figure 1. Effect of increasing the level of nitrogen in the 1000-pound fertilizer mixture. Row on left received 6-8-4; row on right received 4-8-8. Each plot received top-dressing with nitrogen at the rate of 200 pounds of nitrate of soda to the acre. Photo by C. M. Tingle.

growing cabbage. The profits are based upon cabbage selling at an average price of $30.00 per ton. Plots receiving 4 percent nitrogen, in 4-8-4, produced 1 3/4 tons more cabbage to the acre than plots receiving no nitrogen (0-8-4) in the 1000-pound fertilizer mixture. Plots receiving 6 percent nitrogen (in 1000 pounds 6-8-4 fertilizer) produced slightly over a ton more cabbage than plots receiving 4 percent nitrogen in the formula. Increasing the proportions of nitrogen from 6 to 8 percent increased the yields of cabbage from 7.79 to 8.3 tons to the acre. In this experiment, the one-half ton increase in yields due to the 2 percent increase in nitrogen in the fertilizer mixture is not great enough to be of practical importance.

As the yields increased from 4.89 to 6.62 tons to the acre due to the 40 pounds of actual nitrogen supplied in 1000 pounds of 4-8-4, the profits increase from about $81.00 to $124.00, a difference of about $43.00. As the yields further increased due to an additional increase of 20 pounds in actual nitrogen the profits increase to almost $156.00. The profits from the use of 6-8-4 were about $32.00 more than from 4-8-4, and approximately $75.00 greater than the profits from 0-8-4.

Illustrating the stimulating effect of nitrogen on cabbage, figure 1 shows cabbage growing on a plot which received fertilizer carrying 6 percent nitrogen and another plot which received fertilizer carrying 4 percent nitrogen. Each plot received a side dressing with nitrate of soda at the rate of 200 pounds per acre 6 weeks after the plants were set in the field. Each fertilizer was applied at the rate of 1000 pounds per acre before the plants were set in the field.

These data indicate that in order to produce a most profitable crop of cabbage on the soils in this area, approximately 92 pounds of actual nitrogen should be applied to an acre. This amount of actual nitrogen is supplied by 1000 pounds of fertilizer carrying 6 percent nitrogen, applied before setting, plus 200 pounds nitrate of soda or its equivalent applied after the danger of severe cold weather has passed.

Varying Quantity of Phosphorus

The 4-year average effect on cabbage yields of varying the level of phosphorus in a 1000-pound application of fertilizer containing 4 percent nitrogen and 4 percent potash, is also presented in table 6. Little increase in yield was obtained by increasing the levels of phosphorus from 0 (4-0-4) to 16 percent (4-16-4). However, it will be noted in table 3 that in 1941 and 1942 a response was obtained from the application of phosphorus, whereas, during the first 2 years of the experiments very little difference was noted. This can be attributed to the residual effect of the heavy applications of complete fertilizer during the years preceding this experiment.

The 4-year average yields for plots receiving 4-0-4 and 4-4-4 are each 6.84 tons to the acre. Plots receiving 4-8-4 produced slightly lower yields, but the 4-12-4 plots produced 7.48 tons to the acre and the increase of over three-fourths of a ton is large enough to be of practical importance. Increasing the levels of phosphorus above 12 percent gave no increase in yields. The data show that when yields are increased by two-thirds of a ton due to increasing the levels of phosphorus to 12 percent or to 16 percent in the fertilizer formula the profits increase from $138.00 to $147.00. This is an increase of only $9.00 to the acre.

Observations during the fourth year of these investigations indicated further that cabbage respond to fairly high levels of phosphorus. Figure 2, which shows two of the experimental plots in April of 1942, illustrates the response of cabbage to phosphorus.

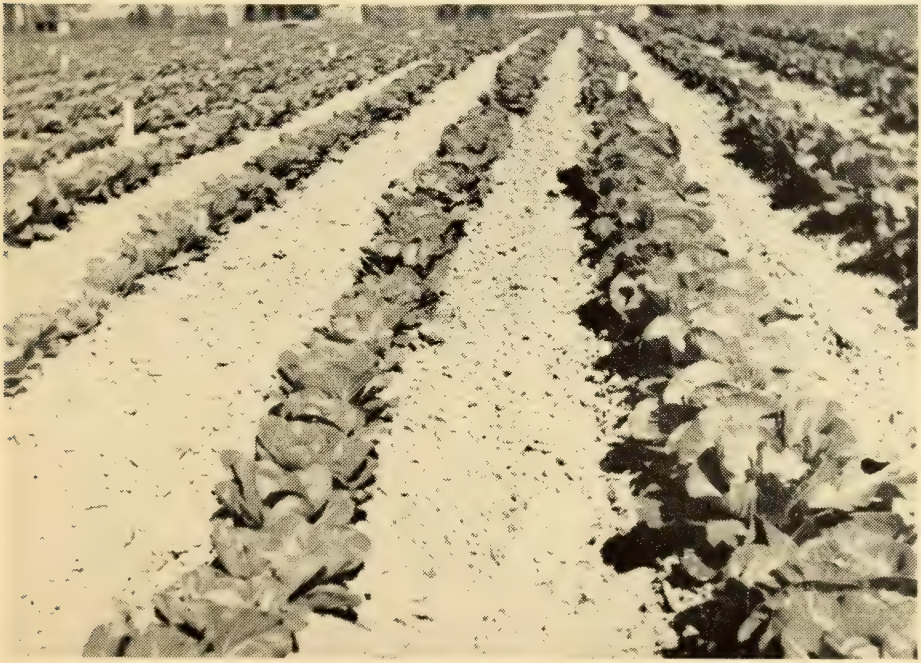

Figure 2. Effect of increasing the level of phosphorus in the 1000-pound fertilizer mixture. Row on left received 4-0-4 (no phosphorus). Row on right received 4-8-4 (8 percent phosphorus). Photo by C. M. Tingle.

From these results it is suggested that in order to produce a good crop of cabbage approximately 90 to 100 pounds of actual phosphorus (P_2O_5) should be applied to the soil. The suggested amount of phosphorus can be supplied in 1100 to 1200 pounds of fertilizer carrying 8 percent phosphorus.

Varying the Quantity of Potash

The effect on cabbage yields of varying potash in a 1000-pound fertilizer mixture containing 4 percent nitrogen and 8 percent phosphorus is presented in table 6. It will be noticed in table 3 that even though there were slight differences between yields from plots which received different levels of potash in 1939, no consistent differences were obtained until 1941 and 1942. This indicates that prior to this experiment, fertilizer usage had been in excess.

The 4-year average yields increased only one-half ton to the acre when the proportions of potash were raised from 0 to 12 percent, an increase not great enough for practical importance. Even in 1942 the difference obtained with varying the proportions of potash were not great. Therefore, under the conditions of this experiment some potash will be needed to produce a most profitable cabbage crop, but perhaps 40 pounds of potash (K_20) per acre is sufficient.

Varying the Rate of 4-8-4 Fertilizer

The results obtained from varying the rates of 4-8-4 fertilizer from 500 to 3000 pounds to the acre are presented in table 7. These data show that as the rate of 4-8-4 is increased from 500 to 1000 pounds to the acre the yields are increased by one ton. Another increment in fertilizer of 500 pounds increases the yield 0.6 of a ton. As the rate of 4-8-4 is raised above 1500 pounds to the acre the increases in yields are not so great. Plots receiving the 2000-pound rate produced less than one-half ton more cabbage per acre than plots receiving the 1500-pound rate.

Considering the results discussed in the cabbage fertilizer formula experiment, attention is directed to the fact that greatest increases in yields were obtained by increasing the proportions of nitrogen. It is also noted that significant differences in yields were not obtained by high applications of phosphorus. Increases in yield with potash, which were not great enough to be important, were obtained only when yields from certain potash (4-8-8) plots were compared with yields from no potash (4-8-0) plots. Inasmuch as these facts were established from studying different fertilizer formulas, the belief is that the increases in yields from higher applications of 4-8-4 are principally due to the increased applications of nitrogen in the 4-8-4 fertilizer. This is further brought out by a comparison of the 4-year average yields from plots receiving 1000 pounds of 6-8-4 plus 200 pounds of nitrate of soda and plots receiving high rates of 4-8-4. The yields

Table 7. Effect of varying the rates of 4-8-4 from 500 to 3000 pounds to the acre upon yields, cost of production, and profits with cabbage.

Fertilizer[1] treatment lbs. 4-8-4	Yield, 4 yr. av. (tons)	Production[2] costs	Profits[3]
500	5.4	$55.90	$106.10
1000	6.4	64.64	127.36
1500	7.0	72.82	137.18
2000	7.4	80.72	141.28
2500	7.9	88.76	148.24
3000	8.0	96.24	143.76

[1] All plots in this experiment received a side dressing with 200 pounds of nitrate of soda to the acre about 6 weeks after the cabbage were set in the field.

[2] Production costs based on 1943 prices.

[3] Profits based on cabbage selling at $30.00 per ton.

from the 6-8-4 (1000 pounds) plots are about 8 tons per acre. The yields from plots receiving the 2500- and 3000-pound rates are approximately 8 tons.

Since the fertilizer formula experiment has shown that nitrogen is the main limiting factor and that 6-8-4 is the most profitable formula to use, the profits received from it make a good comparison with the profits received from the various rates of applying 4-8-4. The data show that profits received from 1000 pounds of 6-8-4 plus 200 pounds of nitrate of soda were $155.95 as compared to $148.24 realized from 2500 pounds of 4-8-4 plus 200 pounds of nitrate of soda. Profits received from 3000 pounds of 4-8-4 were $143.76. The profits from plots fertilized with 6-8-4 plus the side dressing are almost $10.00 greater than the profits from the high rates plots. The profits from 2000 pounds of 4-8-4 to the acre are $141.28. Profits from 1000 pounds of 6-8-4 are almost $15.00 greater. It is seen that the profits favoring the use of 1000 pounds of 6-8-4 increases as the rate of 4-8-4 is decreased. The profit based on the yield from the 1000-pound rate of 4-8-4 in the fertilizer rates tests is $127.36 which is almost identical with the profit received from the 1000 pounds of 4-8-4 in the fertilizer formula tests.

Summarizing the above, it appears that greatest profits from cabbage fertilizers will be obtained from applying about 92 to 100 pounds of nitrogen (N), 90 to 100 pounds of phosphorus (P_2O_5), and 40 pounds of potash (K_2O) to the acre. The suggested amounts of plant food can be approximately supplied by applying 1000 to 1200 pounds of 6-8-4, plus a side dressing with 200 pounds of nitrate of soda or its equivalent.

Experiments With Peas

Varying the Quantity of Nitrogen

The 4-year average yield, the 1943 cost of production, and the estimated profits from peas are presented in table 8. These data show that plots receiving 4-8-4 produced about 1½ times as many hampers of peas as plots receiving 0-8-4. All of the plots received nitrate of soda at the rate of 100 pounds per acre as a side dressing. As the proportion of nitrogen in the 1000-pound fertilizer mixture was increased from 4 to 6 percent, the increase in yield was not great. Plots receiving 4

Table 8. Effect of varying nitrogen, phosphorus, and potash in a 1000-pound fertilizer mixture on average yields, costs, and profits to the acre with peas.

Fertilizer[1] treatment	Yield, 4 yr. av. (hampers)	Production[2] costs	Profits[3]
Varying nitrogen			
0-8-4	69.3	$ 79.97	$ 58.63
4-8-4	107.8	112.61	102.99
6-8-4	114.5	118.88	110.12
8-8-4	118.1	123.29	112.91
Varying phosphorus			
4-0-4	76.4	89.77	63.03
4-4-4	108.4	110.97	105.83
4-8-4	107.8	112.61	102.99
4-12-4	114.5	118.63	110.37
4-16-4	115.4	121.43	109.37
Varying potash			
4-8-0	110.7	112.67	108.73
4-8-4	107.8	112.61	102.99
4-8-8	111.9	116.75	107.05
4-8-12	110.2	117.41	102.99

[1] All plots in this experiment received a side dressing with 100 pounds of nitrate of soda to the acre about 6 weeks after the crop was planted.

[2] Production costs based on 1943 prices.

[3] Profits based on peas selling at an average price of $2.00 per hamper (28 lbs.).

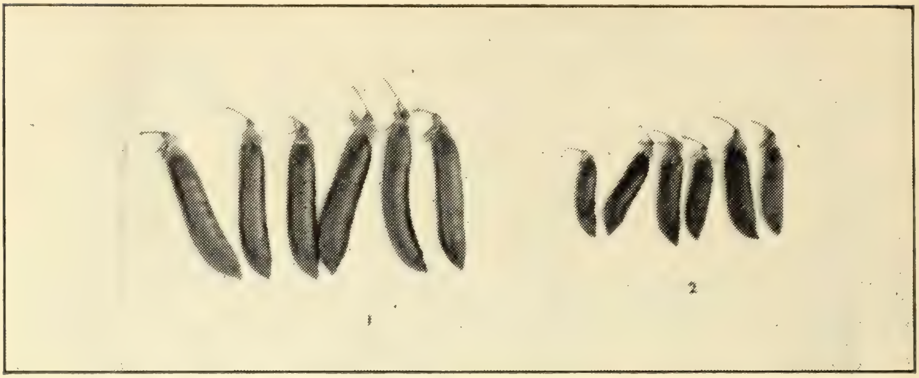

Figure 3. The effect of different levels of nitrogen upon the relative size of pods. Left, peas grown on plots receiving 1000 pounds of 8-8-4 to the acre. Right, peas grown on plots receiving 1000 pounds of 0-8-4 to the acre. All plots received 100 pounds of nitrate of soda to the acre.

percent nitrogen (4-8-4) produced 107.8 hampers of peas, and plots receiving 6-8-4 produced 114.7 hampers to the acre. Plots which received 8-8-4 yielded 118.1 hampers of peas to the acre. As shown in these data increasing the level of nitrogen above 6 percent in the 1000-pound fertilizer mixture does not increase the yields enough to be of practical importance. The response to different levels of nitrogen were much alike from year to year.

These data show that as the yields are increased by 38½ hampers due to increasing the proportions of nitrogen from 0 to 4 percent in the fertilizer formula, the profits increase from $58.63 to $103.00. The increase in profit due to raising the levels of nitrogen above 4 percent is small.

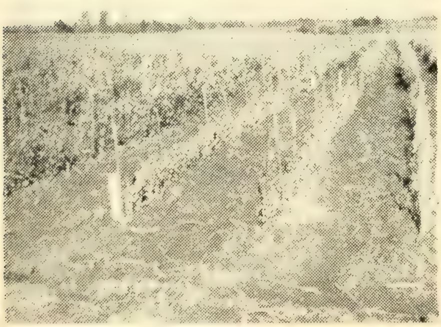

Figure 4. Peas growing on one of the 0-8-4 fertilizer plots.

Observations during these experiments have shown that about 56 pounds of actual nitrogen (N) is sufficient to produce a good crop of peas, and that this amount is essential for the production of good marketable pods. Figure 3 illustrates that nitrogen is essential for the production of long, well-filled, marketable pods. Pods from plots which received only 100 pounds of nitrate of soda to the acre are of definitely inferior quality, and if marketable the price received for them would be very low; whereas, pods from plots receiving 56 pounds of nitrogen are of good quality, well-filled, and of marketable length and shape.

Figure 4 shows young peas growing on a plot which received 1000 pounds of 0-8-4 to the acre and 1000 pounds of nitrate of soda. It is seen that the three rows in the foreground are much smaller and have a lighter color than the plot to the extreme left which received an ample supply (6-8-4) of nitrogen.

Varying the Quantity of Phosphorus

The 4-year average yields of peas obtained from varying the amounts of phosphorus in a 1000-pound mixture also carrying 4 percent nitrogen and 4 percent potash, are presented in table 8. These

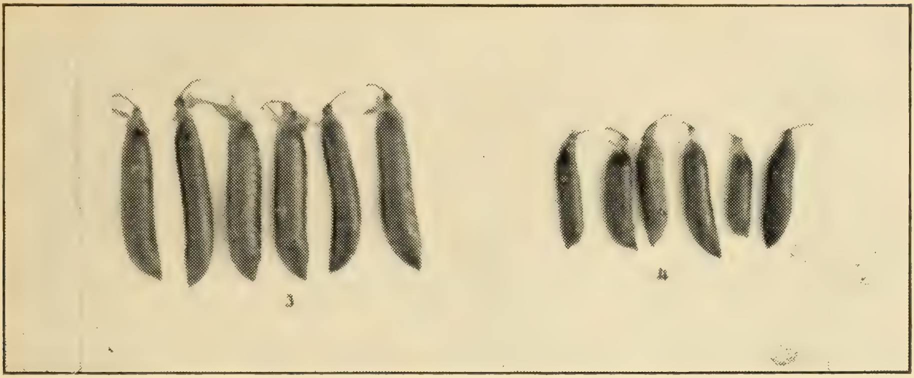

Figure 5. Effect of different levels of phosphorus upon the relative size of pods. Left, peas grown on plots receiving 1000 pounds of 4-12-4 to the acre. Right, peas grown on plots receiving 1000 pounds of 4-0-4 to the acre.

data show increases in yields similar to increases obtained with different amounts of nitrogen. In all 4 years peas responded to applications of phosphorus; however, it was observed that greater response to higher levels of phosphorus were obtained during the last year of the experiment. The 4-year average yields show an increase from 76.4 to 108.4 hampers to the acre as the level of phosphorus was increased from 0 to 4 percent. This increase in yield shows an increase in profit of about $40.00 to the acre. The yields, according to the 4-year average, were not greatly increased by raising the proportions of phosphorus above 4 percent. Considering the yields for each of the 4 years it is seen that in the later years of the experiments the yields were increased by increasing the amount of phosphorus up to 8 percent.

Figure 5 shows that phosphorus is essential for the production of long, well-filled pods.

Figure 6 shows a plot (in the foreground) of peas growing on a (4-0-4) no phosphorus plot. The peas growing to the left of the painted stake have sufficient phosphorus, and a satisfactory growth is being made for the production of large, well-filled pods.

Figure 7 shows peas just before harvest in 1942 growing on two of the experimental plots receiving different levels of phosphorus. In section A the peas are growing in 4-12-4 (12 percent phosphorus) and in B they are on 4-0-4 (no phosphorus). It is seen that the vines growing on the plots receiving phosphorus are reaching the third string and have a good crop of long, well-shaped pods. The vines shown in section B are up only to the second string and have only a few pods which are of poor shape and quality.

It is observed that yields of peas were not greatly increased by increasing the levels of phosphorus above 4 percent (4-4-4 formula). However, the data, the figures, and observations made in the field during 1942 indicate that higher amounts of phosphorus are needed in

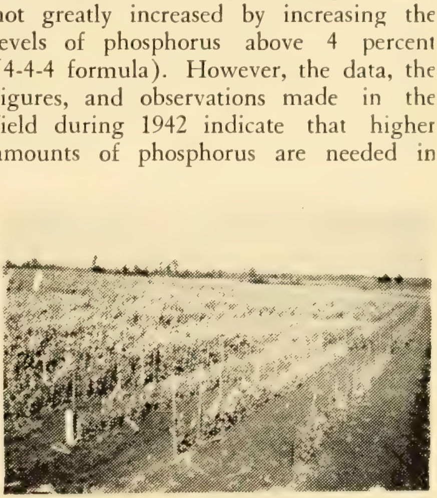

Figure 6. Young peas growing on a no-phosphorus plot. Row on which stake is located and 2 rows to the right received no phosphorus.

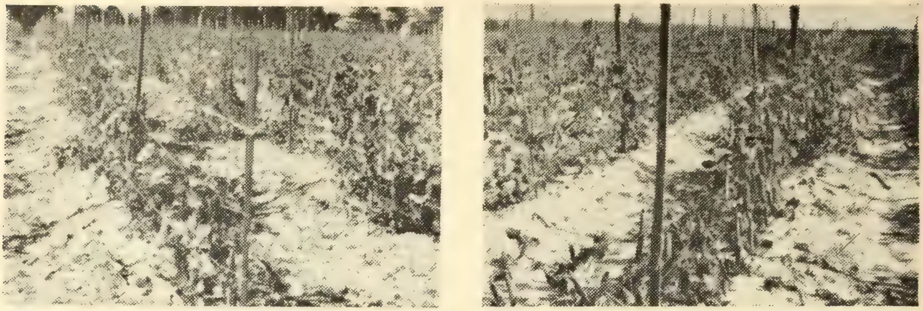

Figure 7. Influence of phosphorus on peas at harvest time. Right, peas growing on 1000 pounds of 4-12-4 to the acre; left, peas growing on 1000 pounds of 4-0-4 to the acre. Photographs made April 23, 1942, by C. M. Tingle.

order to produce a good crop of peas on soils which do not contain large residual quantities of this element as a result of high applications of complete fertilizer for the production of previous crops.

Varying the Quantity of Potash

The data in table 8 show the influence of potash upon yield, costs, and profits, and indicate that the potash requirement for peas is rather low. In fact, peas growing on plots receiving no potash were considered about as good as those receiving 12 percent potash in the 1000-pound fertilizer mixture.

Varying the Rate of 4-8-4 Fertilizer

Data are presented in table 9 on the yields of peas and on profits obtained from varying the rates of 4-8-4 fertilizer from 500 to 3000 pounds to the acre.

These data show that yields of peas were increased with increased rates of 4-8-4 up to 1500 pounds to the acre. These increases are similar to those obtained in varying the amounts of nitrogen and phosphorus in the fertilizer analysis tests.

The data indicate that about 56 pounds of nitrogen, and 100 pounds of phosphorus appear to be needed to produce the most profitable crop of high quality peas. It is believed that more than 40 pounds of potash is excessive. In 1500 pounds of 4-8-4 there is one and one-half times as much potash as suggested. Therefore, it seems more profitable to lower the rate of potash by applying about 1000 pounds of a complete fertilizer which carries 4 percent potash.

The results show that as the rate of applying 4-8-4 is increased from 500 to 1000 pounds the yields increase about 14 hampers. Increasing the rate to 1500

Table 9. Effect of varying rate of 4-8-4 from 500 to 3000 pounds to the acre upon yields, costs, and profits with peas.

Fertilizer[1] treatment lbs. 4-8-4	Yield, 4 yr. av. (hampers)	Production[2] costs	Profits[3]
500	101.0	$101.19	$100.81
1000	115.1	116.99	113.21
1500	124.8	130.15	119.45
2000	122.8	136.29	109.31
2500	124.7	144.77	104.63
3000	127.3	153.67	100.93

[1] All plots in this experiment received a side dressing with 100 pounds of nitrate of soda to the acre about 6 weeks after peas were planted.

[2] Production costs based on 1943 prices.

[3] Profits based on peas selling at an average price of $2.00 per hamper (28 lbs.).

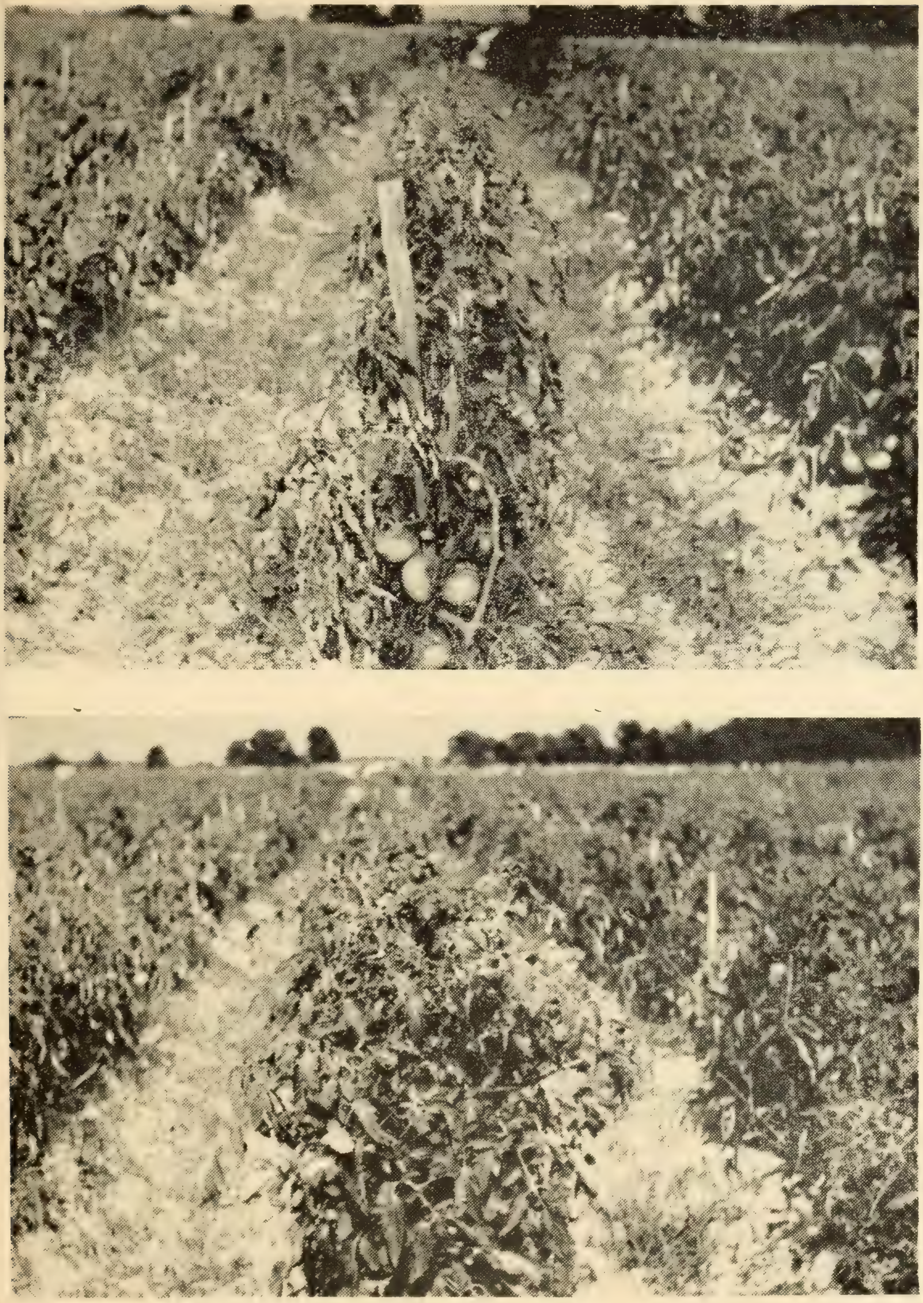

Figure 8. Influence of nitrogen upon growth of tomato plants a week before harvest time. Upper, tomatoes growing on 1000 pounds of 0-8-4 plus 200 pounds of nitrate of soda to the acre; lower, tomatoes growing on 1000 pounds of 6-8-4 plus 200 pounds of nitrate of soda to the acre. Photo by C. M. Tingle.

pounds shows another increase of about 9 hampers. Increasing the rate of 4-8-4 above 1500 pounds shows no increase in yield. The profits increase about $13.00 when the yields are increased by 14 hampers from increasing the rate from 500 to 1000 pounds. As the rates of fertilizer are increased above 1500 pounds the profits drop considerably.

The most profitable production thus appears to result from applications of 56 to 60 pounds of nitrogen (N), 80 to 100 pounds of phosphorus (P_2O_5), and 40 pounds of potash (K_2O). These suggested amounts of plant nutrients are supplied by approximately 1000 pounds of 4-8-4 plus 100 pounds of nitrate of soda to the acre.

Experiments With Tomatoes

Varying the Quantity of Nitrogen

Results obtained from varying nitrogen, phosphorus, and potash and the effect of such variations on the 4-year average yield, costs of production, and profits received from tomatoes, are shown in table 10.

These data show that tomatoes respond to fairly high levels of nitrogen. As the nitrogen is increased in a 1000-pound fertilizer mixture, from 0 (0-8-4) to 4 percent (4-8-4), the yield increases by 55 field boxes. As the nitrogen is increased further to 6 percent (6-8-4) an additional increase of 12 field boxes is obtained. All the plots received a side dressing with 200 pounds of nitrate of soda to the acre.

The data show that profits increase somewhat in proportion to the increase in yield. As the yields increase 55 field boxes, due to the application of the additional 4 percent of nitrogen, the profits increase $156.60. The additional increase of 12 boxes, due to the additional 2 percent nitrogen, results in an increase of $32.50 profit. The plots receiving 8-8-4

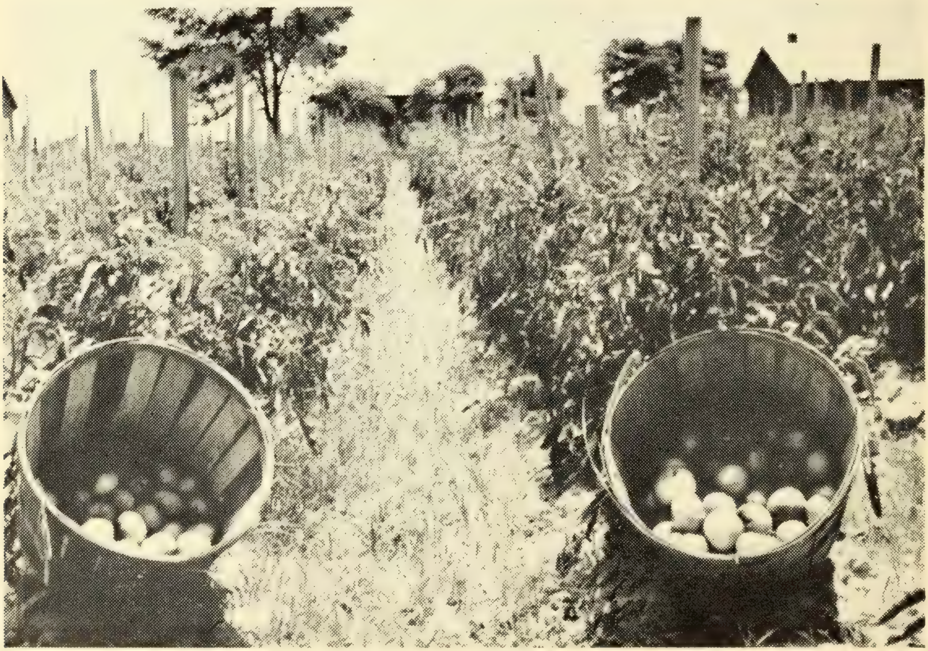

Figure 9. Influence of nitrogen upon yields of tomatoes. Left, 1000 pounds of 4-8-4 plus 200 pounds of nitrate of soda. Right, 1000 pounds of 6-8-4 plus 200 pounds of nitrate of soda. Photo by C. M. Tingle.

Table 10. Effect of varying nitrogen, phosphorus, and potash in a 1000-pound fertilizer mixture in average yields, costs, and profits to the acre with marketable tomatoes.

Fertilizer[1] treatment	Yield, 4-yr. av.[2] (field boxes)	Production[3] costs	Profits[4]
	Varying nitrogen		
0-8-4	118.2	$65.64	$288.96
4-8-4	173.4	74.55	445.65
6-8-4	185.3	77.75	478.15
8-8-4	173.5	79.06	441.44
	Varying phosphorus		
4-0-4	129.1	67.01	320.29
4-4-4	165.0	71.88	423.12
4-8-4	173.4	74.55	445.65
4-12-4	180.1	77.09	463.21
4-16-4	185.1	79.75	475.55
	Varying potash		
4-8-0	173.5	72.88	447.62
4-8-4	173.4	74.55	445.65
4-8-8	185.2	77.18	478.42
4-8-12	185.2	78.86	476.74

[1] All plots in this experiment received a side dressing with 200 pounds of nitrate of soda to the acre.

[2] Field box of tomatoes weighs 70 pounds.

[3] Production costs based on 1943 prices.

[4] Profits based on tomatoes selling for an average of $3.00 per field box.

showed no increase in yields over 6-8-4; therefore, the profits were less since the higher nitrogen fertilizer costs more.

Figure 8, A and B, shows the influence of nitrogen on the growth of tomato plants about one week before harvesting. In A the tomatoes are growing on a plot which received 1000 pounds of 0-8-4 plus the side dressing of 200 pounds of nitrate of soda. In B they are on a plot which received 1000 pounds of 6-8-4 plus a side dressing with 200 pounds of nitrate of soda.

Figure 9 illustrates the difference obtained in yield at the second picking from plots which received 4-8-4 (left) and 6-8-4 fertilizer (right). The two fertilizers were applied at the rate of 1000 pounds per acre and each received the side dressing of 200 pounds of nitrate of soda to the acre.

The foregoing information on nitrogen for tomatoes indicates that for maximum production and greatest profits, approximately 92 pounds of actual nitrogen should be added to the soils in this area. The suggested amount of nitrogen is supplied in a 1000 pounds of complete fertilizer carrying 6 percent nitrogen plus a side dressing with 200 pounds of nitrate of soda to the acre.

Varying the Quantity of Phosphorus

The data in table 10 show that as the amount of phosphorus is increased the yield of tomatoes is increased. An application of 4 percent phosphorus (4-4-4) increased the yields by 36 field boxes per acre. For the next two additional 4 percent increases in phosphorus the yields are increased by approximately 8 field boxes each. As the level of phosphorus is increased above 12 percent (4-12-4) the increase in yield is so low that it is not of practical importance.

It is noted in table 3 that little response was obtained from varying the levels of phosphorus during the earlier years of the experiments. This is attributed to the heavy applications of complete fertilizer applied for commercial production during previous years. However, in 1941, 1942, and in the 4-year average, increased yields were obtained with the higher levels of phosphorus. The results obtained with phosphorus are somewhat similar to those obtained with nitrogen.

The data show that as the yields increase due to increased amounts of phosphorus the profits increase in a corresponding manner. As the proportion of phosphorus is increased from 0 (4-0-4) to 4 percent (4-4-4) the profit increases about $100.00. This increase is about two-thirds as much as that obtained with a similar increase of nitrogen. As the level of phosphorus is increased from 4 percent (4-4-4) to 8 percent (4-8-4) the profit increases about $20.00. It is noted that a similar increase in profit is made when phosphorus is increased to 12 percent (4-12-4). A further increase to 16 percent phosphorus shows an increase in yield over 4-12-4, but the increase is only about $10.00. This gives an increase of $143.00 in profit by the use of 4-12-4 in comparison with 4-0-4, which indicates that the phosphorus requirement for tomatoes on this soil is rather high.

From the above information the indications are that for highest yields and greatest profits about 120 pounds of phosphorus (P_2O_5) should be applied to the soils in this area for tomatoes.

Varying the Quantity of Potash

The results obtained with varied levels of potash, in a 1000-pound fertilizer mixture for tomatoes, show considerable variation in yield from the different amounts of potash in the fertilizer formula. In studying the 4-year average yields (table 10) it is noticed that plots receiving 4-8-0 (no potash) and plots receiving 4-8-4 (4 percent potash) produce the same yield. It is further noted that the yields from plots receiving 4-8-8 or 4-8-12 are identical. However, as the level of potash is increased from 4 percent to 8 percent the yield is increased by almost 12 field boxes.

The profits increase with increased levels of potash and increased yields. As the level of potash is increased from 4 percent (4-8-4) to 8 percent (4-8-8) the profits increase approximately $30.00. Therefore it is profitable to apply fertilizer carrying 60 to 80 pounds of actual potash (K_2O) to tomato land in this area.

Varying the Rate of 4-8-4

Presented in table 11 are the results obtained from varying the rates of applying 4-8-4 fertilizer from 500 to 3000 pounds to the acre upon the 4-year average yields, costs of production, and the profits received from tomatoes.

Yields were increased due to increased applications of 4-8-4 fertilizer up to 2000 pounds to the acre. As the rates of applying 4-8-4 were increased from 500 to 1000 pounds, the yields were increased 22 field boxes per acre. With 1500 pounds of fertilizer per acre, the yields were increased approximately another 15 field boxes. An additional increase of 500 pounds to a total of 2000 pounds of 4-8-4 to the acre shows another increase in yields of about 15 field boxes to the acre. The total increase in yields obtained by increasing the rate from 500 to 2000 pounds of 4-8-4 was 52 field boxes to the acre. The yield of tomatoes was not

Table 11. Effect of varying the rates of 4-8-4 from 500 to 3000 pounds to the acre upon yields, costs, and profits with marketable tomatoes.

Fertilizer[1] treatment lbs. 4-8-4	Yield, 4-yr. av. (field boxes)	Production[2] costs	Profits[3]
500	116.0	$52.62	$295.38
1000	138.4	61.75	353.45
1500	152.2	70.20	386.40
2000	168.3	78.82	426.08
2500	166.0	85.98	412.02
3000	155.6	92.49	374.31

[1] All plots in this experiment received a side dressing with 200 pounds of nitrate of soda to the acre.

[2] Production costs based on 1943 prices.

[3] Profits based on tomatoes selling at $3.00 per field box.

increased by increasing the rate of 4-8-4 fertilizer above 2000 pounds to the acre.

It is noted that the profit (table 11) increases in a manner somewhat similar to the increase in yield. As the rate is increased from 500 to 1000 pounds to the acre the profit increases from $295.39 to $353.45, an increase of about $58.00 above costs. By increasing the rate from 1000 to 1500 pounds to the acre the profits increase approximately $33, or from $353.45 to $386.45. The profits are further increased about $40.00 by increasing the rate from 1500 to 2000 pounds of 4-8-4 to the acre. The application of rates above 2000 pounds of 4-8-4 to the acre results in reduced profits.

In reviewing the data presented in tables 10 and 11 it is noted that increases in yields were obtained by increasing the amounts of nitrogen, phosphorus, and potash applied to the soil. Inasmuch as the greatest response was obtained from applications of nitrogen, the increase in yields obtained from the increased rates can be misleading. It is the opinion that the higher yields obtained from 4-8-8 could be obtained from only 6 percent potash, or from 4-8-6.

Influence of Fertilizer Upon Percentage of Cull Tomatoes

Due to the fact that tomatoes are more or less graded in the field before they are carried to the packing sheds for marketing, it is of interest to note the effect of various amounts of nitrogen, phosphorus, and potash on the percentage of culls.

It is noted in table 12 that culls constitute about 35 percent of the total yield for each treatment. The highest percentage of culls (38 percent) is shown from the use of 8-8-4, while 0-8-4 produced the next highest percent of culls (36½ percent). It thus appears that neither of the nutrients increases or decreases the cull percentages to an appreciable extent. Differences in opinion exist among growers regarding the use of nitrogen in this area. Some have the opinion that high nitrogen encourages rough fruit and lowers the carrying quality of tomatoes. In that regard an observational test was made on the influence of nitrogen upon the carrying quality of tomatoes. Tomatoes from high-nitrogen and from low-nitrogen plots, packed in separate junior lugs, and subjected to identical storage conditions for 15 days, showed no appreciable differences in quality of fruit.

Summarizing, it appears that approximately 90 pounds of nitrogen (N), 120 pounds phosphorus (P_2O_5), and 60 to 80 pounds of potash (K_2O) should be applied to the soil to secure the highest yields and make the most profits from tomatoes in the Crystal Springs area. These amounts are supplied in approximately 1000 pounds of 6-12-6 plus 200 pounds of nitrate of soda per acre, or

Table 12. Effect of varying nitrogen, phosphorus, and potash in a 1000-pound fertilizer mixture upon yield—field boxes per acre.

Fertilizer[1] treatment	Marketable fruit	Cull fruit	Total fruit	Culls
	lbs.	lbs.	lbs.	percent
0-8-4	118.2	68.3	186.5	36.6
4-8-4	173.4	94.3	267.7	35.2
6-8-4	185.3	101.7	287.0	35.4
8-8-4	173.5	107.7	281.2	38.3
4-0-4	129.1	66.5	195.6	34.0
4-4-4	165.0	81.4	246.4	33.0
4-12-4	180.1	91.5	271.6	33.7
4-16-4	185.1	89.5	274.6	32.6
4-8-0	173.5	92.6	266.1	34.8
4-8-8	185.2	90.6	275.8	32.8
4-8-12	185.2	94.0	279.2	33.7

[1] All plots received a side dressing with 200 pounds of nitrate of soda to the acre.

Table 13. The residual effect of varying nitrogen, phosphorus, and potash upon yields of corn following cabbage, peas, and tomatoes.

Fertilizer[1] treatment (1000 lbs. per acre)	Corn yield following cabbage 4-yr. av.	Corn yield following peas 3-yr. av.	Corn yield following tomatoes 2-yr. av.	Av. yield following all three crops
	Influence of nitrogen			
	bu.	bu.	bu.	bu.
0-8-4	31.4	18.7	5.1	18.4
4-8-4	38.6	27.6	8.9	25.0
6-8-4	33.4	31.9	10.0	25.1
8-8-4	32.2	36.9	9.8	26.3
	Influence of phosphorus			
4-0-4	31.0	28.9	7.8	22.6
4-4-4	27.5	24.9	6.8	19.7
4-8-4	38.6	27.6	8.9	25.0
4-12-4	33.8	31.0	9.4	24.7
4-16-4	37.5	27.6	7.3	24.1
	Influence of potash			
4-8-0	26.3	27.1	8.0	20.5
4-8-4	38.6	27.6	8.9	25.0
4-8-8	33.4	29.4	8.2	23.7
4-8-12	39.2	26.5	8.0	24.6

[1] All plots received 200 pounds of nitrate of soda to the acre when corn was about knee high.

by 1200 pounds of 5-10-5 plus 200 pounds of nitrate of soda to the acre, or by 1500 pounds of 6-8-4 without the side dressing.

Experiments With Corn Following Truck Crops

It is a common practice among growers in the Copiah area to grow corn without additional fertilizer following cabbage, peas, and tomatoes. In some instances the growers side dress the corn with 200 pounds of nitrate of soda to the acre when the corn is about knee high. Corn was planted in these experiments following each crop without additional fertilizer, similar to common practice.

The yields of corn obtained from varying the levels of nitrogen, phosphorus, and potash applied to cabbage (table 13) are much alike. It is noted, however, from the 4-year average yields that greatest yields were obtained from plots which received a moderate supply of each of the nutrients. It is also noted that the yield of corn following cabbage is very good.

The yield of corn following peas increased when increased amounts of nitrogen were applied. As the proportions

Table 14. Influence upon the subsequent yield of corn of varying the rates of 4-8-4 from 500 to 3000 pounds to the acre with cabbage, peas, and tomatoes.

Fertilizer[1] treatment	Corn yield following cabbage 4-yr. av.	Corn yield following peas 4-yr. av.	Corn yield following tomatoes 2-yr. av.	Av. yield following all three crops
lbs.	bu.	bu.	bu.	bu.
500	21.5	21.8	15.5	19.6
1000	23.7	24.5	16.0	21.4
1500	28.8	29.3	17.0	25.0
2000	33.4	33.3	19.8	28.8
2500	36.0	35.6	21.0	30.9
3000	34.5	38.0	21.6	31.4

[1] Fertilizer was applied to the preceding crop. The corn received a uniform side dressing with 200 pounds of nitrate of soda to the acre.

of nitrogen were increased from 0 to 4 percent the yields were increased about 10 bushels to the acre. Varying the levels of phosphorus with peas did not influence the subsequent yield of corn.

Corn yields were also increased by increasing the amount of nitrogen in the fertilizer applied to tomatoes. As the nitrogen was increased from 0 to 6 percent, the yields of the following corn crop were doubled. Varying the amount of phosphorus and potash with tomatoes had little effect upon the subsequent corn yields.

The corn yields were gradually increased by increasing the rate of 4-8-4, applied to preceding crops of cabbage, peas, and tomatoes, but the increase in yields due to each 500 pounds increment of fertilizer is too small to be of practical importance; each 500-pound increment in fertilizer only increased the following corn yields about 2 or 3 bushels to the acre. When the increase in profits of cabbage, peas, or tomatoes is added to the increase in the corresponding corn yields, the increase in yields of corn due to increased fertilizer rates is not great enough to change the rates suggested for each of the three truck crops.

The results obtained with corn following tomatoes indicate that it is not an economical practice to grow corn after tomatoes in this area. During the 4-year period, yield data were recorded only 2 out of the 4 years. The yields obtained during the other 2 years were so poor that the corn was not worth harvesting. The ears from corn following tomatoes were short, poorly filled, and in most instances of no value. Therefore, it is suggested that tomatoes be followed with a summer cover crop rather than with corn.

Bulletin 398 February 1944

Cotton Variety Tests
in the
Yazoo-Mississippi Delta

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

SUMMARY

The data from the six cotton variety studies which were conducted in 1943 by the Delta Branch Experiment Station in the Yazoo-Mississippi Delta at Stoneville, Marks, Money, Heathman, Valley Hill, and Yazoo City were combined and analyzed. The results are given in table 7.

Leading money value producers were Stoneville 2B, Stoneville 2C, and Deltapine 14, followed closely by Miller, Delfos 651, Rowden, and Bobshaw 1.

While the staple lengths of all strains are less than normally produced, the lengths of Delfos 444, Delfos 531C, Delfos 651, and Coker 100-7 probably were decreased by weather conditions to a greater extent than were the lengths of the other varieties. This effect was, obviously, reflected in the money value of the production of these cottons.

The earliest varieties were Bobdel, Delfos 444, Delfos 531C, and Delfos 651. Late varieties were Wilds 15, Rowden, and Deltapine 14. Outstanding in fiber strength were Wilds 15, Bobshaw 1, Bobdel, and Rowden. In regard to fiber length uniformity, Rowden, Miller, Bobshaw 1, Bobdel, and Deltapine 14 lead the list. Where particular fiber qualities lead to increased premiums from cotton manufacturers, there will be changes in money values. Qualities contributing to spinning value include staple length, uniformity, and strength; no single quality definitely determines this value.

In determining the performance of a group of cotton varieties, conclusions should not be based upon a single year's results.

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Cotton Variety Tests in the Yazoo-Mississippi Delta

By J. WINSTON NEELY and SIDNEY G. BRAIN
Delta Branch Experiment Station, Stoneville

In order to determine the adaptation of cotton varieties to Delta farming conditions, field tests have been conducted by the Delta Branch Station for many years. The Station has adopted the practice of testing the varieties on selected plantations in representative sections of the Delta in order to evaluate the performance of the various cottons under, as nearly as possible, the same conditions that they are to be grown by Delta planters.

During the 1943 season, 12 varieties were tested at Stoneville, Marks, Money, Heathman, Valley Hill, and Yazoo City. The yields of seed cotton and lint in pounds per acre, gin turn-out, staple length, number of bolls required to make a pound of seed cotton, percentage of total production picked during the first picking, estimated Chandler bundle strength of fiber, uniformity of fiber length, and total money value per acre, based upon three grades (Middling, Strict Low Middling, and Low Middling), are reported.

The yields of each variety are based upon the weights of seed cotton harvested from 10, one-row plots at each location. Gin turn-out values for each variety were determined by ginning ten, 100-boll samples from each location on a 10-saw gin. Satisfactory efficiency of these samples in determining lint percentages was verified in a special study. Lint percentages for the Stoneville study, using 100-boll samples, were compared with lint percentages from 60-pound lots taken from the same test.

Staple lengths given are averages of lengths of 10 samples for each variety from each location, determined by three different classers through the cooperation of the Staple Cotton Cooperative Association, Greenwood, Mississippi; the Board of Supervising Cotton Examiners of the Food Distribution Administration, Memphis, Tennessee; and the Board of Cotton Examiners of the Food Distribution Administration, Jackson, Mississippi. The size of boll was determined by averaging the weights of ten, 100-boll samples from each variety at each of the locations.

The percentage of cotton obtained from the first picking, which is considered a measure of earliness, was determined by dividing the weight of the first picking by the weight of the total production. Unfortunately, all of the production was harvested in one picking at Marks and at Valley Hill, and earliness data for these locations are not available. The estimated Chandler bundle strength and the fiber length uniformity were determined in the Stoneville Fiber Laboratory of the Food Distribution Administration. The strength and uniformity of length of fiber influence the spinning quality of cotton and are very important characteristics to which the growers, breeders, buyers, and millers are paying much more attention than they did a short time ago.

The acre values are based upon the following information: Yields of seed and lint; the average prices for cotton of the respective grades and several lengths for the 10 weeks of the 1943 marketing season in Memphis, beginning the third week in August; and seed valued at $56 per ton.

Differences required for significance between varietal averages for each of the characteristics were determined in an accepted manner. These values are found in the bottom two lines of the tables.

Table 1. Stoneville cotton variety test, 1943.

Variety	Yield per acre		Gin turnout	Staple length	Bolls per lb. cotton seed	Percent picked first picking	Est. Chandler bundle strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	lbs.	lbs.	percent	inches	bolls	percent	lbs. sq. in.	percent	dols.	dols.	dols.
Bobdel (Bobshaw 16)	1848	584	31.6	1-1/8	79.6	68.1	89,700	77.3	178	163	136
Bobshaw 1	1736	621	35.8	1-1/16	79.9	61.5	91,100	77.0	165	154	134
Coker 100-7	1807	645	35.7	1-3/32	79.1	57.8	85,000	73.3	176	164	141
Delfos 444	1850	531	28.7	1-5/32	91.3	64.8	81,400	74.1	176	159	133
Delfos 531C	2036	664	32.6	1-1/8	85.6	61.0	81,500	70.5	201	183	153
Delfos 651	2080	695	33.4	1-1/8	83.7	63.2	82,500	71.8	209	190	159
Deltapine 14	1980	802	40.5	1-3/32	86.5	56.6	82,200	75.4	211	197	167
Miller	1950	706	36.2	1	67.9	61.2	83,200	78.7	180	170	150
Rowden (Roldo)	1871	649	34.7	1-1/32	61.1	42.3	83,900	80.6	170	161	142
Stoneville 2B	2181	781	35.8	1-3/32	69.9	59.5	83,900	72.9	213	199	170
Stoneville 2C	2228	753	33.8	1-3/32	73.5	57.0	86,200	72.4	209	195	167
Wilds 15	1562	476	30.5	1-1/4	83.9	41.9	95,200	73.0	175	154	120
Dif. barely significant	197	68	.6	1/32	2.5	5.9	2,100	2.7	23	20	16
Dif. highly significant	260	90	.7	1/32	3.2	7.8	2,800	3.6	30	27	21

The difference between any two varietal averages in a column must be equal to or exceed the values found at the bottom of the table in order to be considered significant.

The 1943 growing season in the Yazoo-Mississippi Delta was characterized by long periods of excessively high temperatures and, except in small areas, a marked deficiency in rainfall.

Exceptionally good and uniform stands were obtained in all tests.

Stoneville Test

The Stoneville test is located at the Delta Branch Experiment Station. The soil is a sandy loam, typical of Deer Creek banks. Nitrate of soda, at the rate of 200 pounds per acre, was "bedded-on" about 4 weeks before planting. The test was planted on April 21, but full stands were not obtained until May 12, because of a deficiency of moisture prior to May 8. After setting a heavy crop, the plants went into an extreme drought condition, which existed throughout the remainder of the season. Very small bolls and unusually short fibers resulted. The early, fast-fruiting varieties with light foliage were affected more than the later, heavier foliaged, slower-fruiting varieties. This is the result of the water requirements of the fast-fruiting varieties being much higher during boll maturation, since a larger number of bolls were consuming water during a given period. The first picking was made on August 17, and the final picking on October 12. Results of the Stoneville test are given in table 1.

Marks Test

In cooperation with L. J. Barksdale, a variety test was conducted in the northern part of the Delta in Quitman County, 8 miles west of Marks. The soil varies from a fine sandy loam to a silt loam. The test was fertilized with nitrate of soda at the rate of 200 pounds per acre, which was "bedded-on," and it was planted on May 3. Germination took place soon after planting, but the soil was dry, and early growth was slow until the latter part of May. Drought conditions were not as obvious as they were at other locations, but the short stature of plants (28 to 30 inches), small bolls, and short staple indicate clearly a deficiency of soil

Table 2. Marks cotton variety test, 1943.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Est. Chandler bundle strength	Fiber length uni-formity	Total money value		
	Seed cotton	Lint						Mid-dling	Strict low middling	Low mid-dling
	lbs.	lbs.	percent	inches	bolls	lbs. sq. in.	percent	dols.	dols.	dols.
Bobdel (Bobshaw 16)	1617	545	33.7	1-1/16	86.5	91,600	75.6	149	138	120
Bobshaw 1	1737	641	36.9	1-1/32	86.7	90,600	75.9	164	156	137
Coker 100-7	1590	584	36.7	1-1/32	88.2	85,300	71.1	150	142	125
Delfos 444	1616	498	30.8	1-3/32	96.0	81,400	73.4	142	133	115
Delfos 531C	1714	586	34.2	1-3/32	92.4	83,600	70.3	162	151	130
Delfos 651	1759	607	34.5	1-1/16	89.0	82,800	70.6	163	152	133
Deltapine 14	1626	681	41.9	1-1/32	94.2	82,200	76.8	168	159	139
Miller	1685	623	37.0	31/32	71.0	86,600	78.4	156	148	131
Rowden (Roldo)	1780	644	36.2	1	64.1	87,000	79.3	164	155	137
Stoneville 2B	1811	654	36.1	1-1/32	74.6	84,300	71.9	169	160	141
Stoneville 2C	1787	622	34.8	1-1/16	77.6	86,200	74.0	167	156	136
Wilds 15	1362	452	33.2	1-3/16	96.2	93,200	72.4	152	136	111
Dif. barely significant	111	40	.6	1/32	2.0	2,500	2.3	11	10	9
Dif. highly significant	147	53	.7	1/32	2.7	3,300	3.1	14	13	11

moisture due to subnormal rainfall during the winter and growing seasons. Boll-weevil infestations were very light, and the percentage of wilt affected plants was low. The entire production was picked on September 28, and earliness data were not obtained. The results of the Marks test are presented in table 2.

Money Test

In order to determine the relative performance of cotton varieties in the Tallahatchie River Basin, a test was conducted on Wildwood Plantation in Leflore County, near Money, in cooperation with H. L. Gary. The soil of the Money field varies from a fine sandy loam to a silt

Table 3. Money cotton variety test, 1943.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Est. Chandler bundle strength	Fiber length uni-formity	Total money value		
	Seed cotton	Lint							Mid-dling	Strict low middling	Low mid-dling
	lbs.	lbs.	percent	inches	bolls	percent	lbs. sq. in.	percent	dols.	dols.	dols.
Bobdel (Bobshaw 16)	1679	534	31.8	1-3/32	80.3	74.7	88,200	78.7	151	141	122
Bobshaw 1	1687	584	34.6	1-1/16	76.9	67.2	88,900	80.1	157	147	128
Coker 100-7	1478	508	34.4	1-3/32	78.7	69.8	81,100	72.2	140	131	112
Delfos 444	1645	466	28.3	1-1/8	87.0	70.7	79,500	77.8	147	135	113
Delfos 531C	1563	502	32.1	1-3/32	85.3	74.6	82,400	73.0	141	132	114
Delfos 651	1574	515	32.7	1-1/8	84.0	71.0	80,900	72.9	156	142	118
Deltapine 14	1572	637	40.5	1-1/16	84.3	57.9	80,200	79.3	163	152	132
Miller	1727	610	35.3	1	67.8	71.4	82,700	80.4	157	148	131
Rowden (Roldo)	1582	547	34.6	1-1/32	62.4	68.4	84,800	82.6	143	136	120
Stoneville 2B	1855	636	34.3	1-3/32	71.7	69.5	84,600	77.0	176	164	141
Stoneville 2C	1771	568	32.1	1-3/32	73.7	64.0	84,100	76.0	160	150	129
Wilds 15	1223	366	29.9	1-1/4	82.7	65.0	93,600	75.2	135	119	93
Dif. barely significant	224	79	.6	1/32	3.1	5.1	2,200	2.0	22	21	17
Dif. highly significant	296	105	.8	1/32	4.1	6.7	3,100	2.6	30	27	23

loam, and an influence of outwash from the hills exists. A heavy growth of hairy vetch was turned under 3 weeks before planting, and nitrate of soda, at the rate of 200 pounds per acre, was "bedded-on." During the last part of May the cotton was side-dressed with 100 pounds of sulphate of ammonia. The plots were planted on April 23, but germination was delayed considerably because of a deficiency of moisture. During the growth of the plants and the setting of a large part of the bolls, sufficient rainfall occurred; however, at the time of the maturation of the bolls, there was some deficiency of moisture, and consequently shorter than normal staples were obtained. The first picking was made on August 26, and the final picking on September 30. The results are given in table 3.

Heathman Test

The Heathman test in Sunflower County was conducted in cooperation with W. J. Godbold on the Bobshaw Plantation, and is located on Highway 82. The soil is a light-colored, well-drained, silt loam. A heavy growth of hairy vetch was turned under about three weeks before planting, and nitrate of soda, at the rate of 200 pounds per acre, was "bedded-on." The test was planted on May 1. Good stands were obtained immediately. Mature plants were 24 to 30 inches tall. While there were no obvious signs of stress during the growing season, a deficiency of moisture is reflected in the small bolls and short staple. Insect infestations were very light, and diseases of no consequence. The first picking was made on August 30, and the final picking on September 25. Results are given in table 4.

Table 4. Heathman cotton variety test, 1943.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Est. Chandler bundle strength	Fiber length uni-formity	Total money value		
	Seed cotton	Lint							Mid-dling	Strict low middling	Low mid-dling
	lbs.	lbs.	percent	inches	bolls	percent	lbs. sq. in.	percent	dols.	dols.	dols.
Bobdel (Bobshaw 16)	1399	464	33.2	1-1/16	91.2	81.5	90,500	75.2	126	118	103
Bobshaw 1	1489	545	36.6	1	87.1	76.0	93,100	77.7	139	131	116
Coker 100-7	1375	492	35.8	1-1/32	91.5	78.0	84,900	71.6	127	121	106
Delfos 444	1423	418	29.4	1-3/32	99.4	84.8	82,500	73.9	121	114	98
Delfos 531C	1429	476	33.3	1-1/16	97.0	81.1	84,200	72.4	129	121	105
Delfos 651	1486	501	33.7	1-1/16	94.0	83.6	84,500	73.2	138	130	112
Deltapine 14	1350	563	41.7	1	97.9	71.5	80,600	77.2	138	130	114
Miller	1554	555	35.7	31/32	74.8	82.7	85,300	78.3	141	133	118
Rowden (Roldo)	1549	539	34.8	1	67.7	80.4	87,000	77.2	139	132	116
Stoneville 2B	1711	609	35.6	1-1/32	77.6	77.3	84,200	74.3	158	150	132
Stoneville 2C	1725	593	34.4	1-1/16	77.4	77.5	85,600	73.3	159	149	130
Wilds 15	1138	379	33.3	1-3/16	97.2	66.0	93,400	72.7	127	114	93
Dif. barely significant	101	38	.7	1/32	2.9	4.5	2,200	2.2	10	9	8
Dif. highly significant	133	50	.9	1/32	3.8	6.0	3,000	2.8	13	13	11

Valley Hill Test

The Valley Hill field is in Carroll County, about six miles east of Greenwood, and is on the eastern border of the Delta. The variety test at this location was conducted in cooperation with L. S. Hemphill. The surface soil, although it contains some sand, is a light-colored, well-drained, silt loam made up largely of outwash from the hills. The plots were fertilized with nitrate of soda,

Table 5. Valley Hill cotton variety test, 1943.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Est. Chandler bundle strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint						Middling	Strict low middling	Low middling
	lbs.	lbs.	percent	inches	bolls	lbs. sq. in.	percent	dols.	dols.	dols.
Bobdel (Bobshaw 16)	1160	368	31.7	1-1/16	86.6	85,700	79.8	101	95	83
Bobshaw 1	1231	417	33.9	1-1/16	87.5	87,800	79.4	113	105	92
Coker 100-7	1149	409	35.6	1-1/16	83.0	80,100	74.6	109	102	88
Delfos 444	1127	325	28.8	1-3/32	95.2	74,500	78.3	95	89	77
Delfos 531C	1161	375	32.3	1-3/32	91.2	79,700	74.7	105	99	85
Delfos 651	1225	409	33.4	1-1/16	92.4	80,400	73.9	111	104	91
Deltapine 14	1091	429	39.3	1-1/16	93.3	80,800	78.2	111	103	90
Miller	1453	527	36.3	31/32	71.5	82,600	80.6	133	126	112
Rowden (Roldo)	1425	497	34.9	1	65.7	85,700	82.0	128	121	107
Stoneville 2B	1332	466	35.0	1-1/16	77.9	82,500	75.9	125	117	101
Stoneville 2C	1334	442	33.1	1-1/16	77.9	81,700	77.8	120	113	98
Wilds 15	1019	309	30.3	1-3/16	88.5	90,300	77.4	106	95	78
Dif. barely significant	112	39	.6	1/32	2.4	2,200	2.3	11	10	9
Dif. highly significant	149	52	.8	1/32	3.1	2,900	3.1	14	13	11

at the rate of 200 pounds per acre, which was "bedded-on," and they were planted on April 30. Moisture was sufficient to promote good growth and heavy fruiting, except in rather large parts of the field, where the underlying, coarse, leached sand is close to the surface. Bolls were smaller and staples shorter in 1943 than they were in 1942, when excessive amounts of rain fell in the early part of the growing season. Boll-weevil infestations were very light, but some decrease in yield probably resulted from the effects of an unidentified leaf-spot

Table 6. Yazoo City cotton variety test, 1943.

Variety	Yield per acre		Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking	Est. Chandler bundle strength	Fiber length uniformity	Total money value		
	Seed cotton	Lint							Middling	Strict low middling	Low middling
	lbs.	lbs.	percent	inches	bolls	percent	lbs. sq. in.	percent	dols.	dols.	dols.
Bobdel (Bobshaw 16)	1683	545	32.4	1-3/32	81.6	62.7	86,900	78.5	153	143	123
Bobshaw 1	1859	666	35.8	1-1/32	82.8	62.0	84,800	82.3	172	163	144
Coker 100-7	1567	566	36.1	1-3/32	83.6	62.5	80,200	75.9	154	144	123
Delfos 444	1594	472	29.6	1-1/8	90.5	63.7	77,000	77.1	147	134	113
Delfos 531C	1677	558	33.3	1-3/32	88.2	60.9	80,500	72.9	155	145	125
Delfos 651	1829	611	33.4	1-3/32	86.2	59.5	78,800	75.8	170	159	136
Deltapine 14	1904	775	40.7	1-1/16	88.9	55.8	78,600	78.2	199	185	160
Miller	1876	687	36.6	1	68.0	57.9	79,500	81.8	175	165	146
Rowden (Roldo)	1864	660	35.4	1	62.4	46.5	82,000	83.4	170	160	142
Stoneville 2B	1982	692	34.9	1-3/32	74.7	57.8	84,300	76.5	190	178	152
Stoneville 2C	1995	674	33.8	1-3/32	77.1	50.6	84,000	76.0	187	175	150
Wilds 15	1457	443	30.4	1-1/4	85.2	45.2	91,100	75.8	163	143	112
Dif. barely significant	178	65	.6	1/32	2.3	4.7	2,400	2.1	19	17	14
Dif. highly significant	236	86	.7	1/32	3.0	6.2	3,200	2.8	25	22	19

disease. The whole crop was picked on September 24, and for that reason earliness data were not obtained. Results are presented in table 5.

Yazoo City Test

In cooperation with Marx Schaefer, the variety test for the southeastern part of the Delta was conducted on his farm 3 miles west of Yazoo City. The soil varies from a fine sandy to a silt loam and is well to medium-well drained. A good growth of mixed vetch was turned under about three weeks before planting, and nitrate of soda, at the rate of 200 pounds per acre, was "bedded-on." The test was planted on April 24 and, although germination was slow, good and uniform stands were obtained. Mature plants were only 24 to 30 inches tall, and severe symptoms of a lack of moisture were observed soon after the fruit was set, and existed throughout the remainder of the season. Boll-weevil infestations were very light, and wilt was of no importance. The first picking was made on August 18, and the final picking October 12. The yield and other data are presented in table 6.

Table 7. Yield and other data from cotton variety tests conducted at six locations in the Yazoo-Mississippi Delta, 1943.

Variety	Yield per acre: Seed cotton	Yield per acre: Lint	Gin turn-out	Staple length	Bolls per lb. seed cotton	Percent picked first picking*	Est. Chandler bundle strength	Fiber length uniformity	Total money value: Middling	Total money value: Strict low middling	Total money value: Low middling
	lbs.	lbs.	percent	1/32 in.	bolls	percent	lbs. sq. in.	percent	dols.	dols.	dols.
Bobdel (Bobshaw 16)	1564	507	32.4	34.6	84.3	71.8	88,800	77.5	142	133	115
Bobshaw 1	1623	578	35.6	33.2	83.5	66.7	89,400	78.7	150	142	125
Coker 100-7	1494	533	35.7	34.3	84.0	67.0	82,800	73.1	142	132	115
Delfos 444	1543	452	29.3	35.5	93.2	71.1	79,300	75.8	141	129	109
Delfos 531C	1597	527	33.0	34.8	90.0	69.4	82,000	72.3	147	138	118
Delfos 651	1659	556	33.5	34.9	88.2	69.3	81,600	73.0	155	145	124
Deltapine 14	1587	647	40.8	33.6	90.9	60.5	80,800	77.5	166	154	133
Miller	1708	618	36.2	31.5	70.2	68.3	83,300	79.7	158	149	132
Rowden (Roldo)	1679	589	35.1	32.2	63.9	59.4	85,100	80.9	152	144	127
Stoneville 2B	1812	640	35.3	34.1	74.4	66.0	84,400	74.8	171	160	139
Stoneville 2C	1807	609	33.7	34.6	76.2	62.3	84,600	74.9	169	158	136
Wilds 15	1294	405	31.3	39.0	89.0	54.5	92,900	74.4	142	126	101
Dif. barely significant	65	23	.2	0.2/32	1.0	2.0	800	.9	7	6	5
Dif. highly significant	86	30	.3	0.3/32	1.4	2.7	1,100	1.2	9	8	7

*Based upon four locations only.

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Tomato Production In Mississippi

War-time tomato pickers harvesting the fall crop.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

Summary and Recommendations

1. The tomato may be grown in many types of soil, but must have good drainage for early production.

2. A complete fertilizer, such as 5-10-5 or 4-8-4, is recommended for most of the hill soils of the State. An application of 1000 to 1200 pounds per acre of the complete fertilizer before planting, plus 150 or 200 pounds of nitrate of soda or its equivalent as a side dressing at blooming time, is needed for a great many of the soils in the State.

3. Strong stocky plants with partial hardening are highly desirable for the early crop. These are produced in pots or cold frames after being started in hot beds.

4. Plants for the early tomato crop are set in the field just as soon as it appears that the danger of frost is over. It is better to set them in a settled seedbed.

5. Fall tomatoes should be set in the field in central Mississippi during the first half of July.

6. Close spacings for pruned and staked tomatoes produce higher total yields and much higher early yields. If pruned to one stem, they should be spaced 18 inches or closer in the row.

7. Two stems per plant are more profitable in Mississippi than one stem per plant, and they should be spaced from 18 to 24 inches in the row when pruned to two stems and staked.

8. Fall tomatoes usually do better if left on the ground than if pruned and staked. They can stand the hot dry weather better on the ground.

9. Scarlet Dawn is a good early smooth variety, but it is not resistant to fusarium wilt. However, it can be grown successfully if a long-time rotation system is practiced.

10. Stokesdale, Rutgers, and Marglobe are fairly good varieties that are partially resistant to fusarium wilt.

11. Pan America is a new variety that is highly resistant to fusarium wilt; it has good eating quality, but the yield on wilt-free soil has not been as high as those mentioned above.

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Tomato Production in Mississippi

L. R. FARISH,* Delta Branch Experiment Station, Stoneville
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Tomatoes have been grown for the fresh market in this State for almost half a century and have become an important truck crop in Copiah and adjacent counties. The tomato fruits in this area have been harvested in the green mature stage for shipment to the northern markets. They were usually allowed to partially ripen in the cars before being unloaded, but more recently the trend has been toward harvesting in the pink stage and unloading immediately after arrival at the terminals. Some tomatoes have been grown in other parts of the State for local fresh markets, and they are grown throughout the State for home consumption. In recent years, a limited acreage of canning tomatoes has been grown in the southern part of the State.

Tomato plantings have been made on many kinds of soil, and some of these were not properly drained for early tomatoes. Many plantings have been made on poor hill soils which were too low in organic matter and nutrients for profitable tomato production, and some commercial growers make the mistake of not growing cover crops to supply this badly needed organic matter.

Fertilization has varied from no fertilizer to more than a ton of complete fertilizer per acre, and in some cases the grower did not realize enough income from the crop to pay for the fertilizer.

In many instances weak and spindling plants have been set, which would not be expected to produce good yields, and in other instances the plants were set too late for the greatest profits. Sometimes plants improperly set fail to grow normally.

Practically all the tomatoes grown in the Copiah County area for shipment to distant markets have been pruned to a single stem and staked; and, previous to 1940, the tops were pinched out above the third cluster in many of the plantings. In some instances pruning and staking of tomato plants have been practiced when grown for home use and for the local market, while in other instances the plants were allowed to sprawl on the ground. Planting distances of the pruned and staked plants have varied in the row from 24 to 36 inches.

A number of tomato varieties have been grown in this State in past years. Some of these varieties were not adapted to the soil and climatic conditions where grown, which resulted in great losses to the growers.

Disease and insect pests are oftentimes not kept under control, and complete crop failures have often been the result.

It is the purpose of this bulletin to discuss the various practices in tomato culture which have led to successful production on experimental fields located in three sections of Mississippi.

Soil Management, Preparation, and Fertilization

Tomatoes are grown on many soil types but are quite sensitive to soil drainage. They cannot stand a poorly drained or "water-logged" soil, and the proper drainage must be given before planting the crop. The tomato plant is not very sensitive to soil reaction, but benefits from liming have been reported where the soil is very acid and deficient in calcium and magnesium. If lime is used, it is usually better to apply it before planting a winter cover crop in the fall and let the tomatoes follow the cover crop. Silt, silt loam, and sandy loam soils are considered more desirable for tomatoes than light sandy or heavy clay soils.

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*Editor's note: Mr. Farish was formerly associate horticulturist for the Mississippi Agricultural Experiment Station, and conducted the experiments herein reported from State College.

Most soils in this State are deficient in organic matter, indicating the need for a cropping system which will add organic matter to such soils before planting them to tomatoes. When available, manure is a good source of organic matter; but, if it is not available, some kind of green manure crop should be grown previous to the tomato crop. Sometimes it is more convenient to grow a summer cover crop, while at other times an early winter cover crop fits better into the cropping system. The objection to planting vetch or winter peas or other fall-planted legumes as a cover crop is that they usually do not produce sufficient growth before turning is necessary in preparation for an early tomato crop. Cutworms are also apt to give trouble if tomato plants are set immediately after plowing under a winter legume.

A practice which has proven satisfactory among some growers in the trucking area is to plow under either manure or summer legume cover crop and broadcast either oats or rye before bedding the land in the early fall. The oats or rye help to prevent soil erosion during the rainy winter months. Then 1000 to 1200 pounds of a complete fertilizer (such as 4-8-4 or 5-10-5) is applied per acre in the drill before rebedding the land in preparation for setting the early crop of tomatoes. The fertilizer should be placed rather deep and several inches to the side of the row's center, where the plants are to be set. Roots of the young plants should not be placed in direct contact with heavy applications of complete fertilizers. A side dressing of 150 or 200 pounds per acre of nitrate of soda, or its equivalent, is made about the time the plants are blooming. Some sections, such as the Delta, do not need the above specified amounts of fertilizer applied for tomatoes.

Plant Production

Securing strong stocky plants that are ready to be set in the field at the proper time is a most important factor in early tomato production. The type of plants does not seem to be so important for the fall crop, provided they survive the transplanting; but this is extremely important for the early crop. If long tender hotbed plants, which have been crowded in the bed and have had no hardening, are set in the field in the early spring, the shock seems to be so great that many of them never produce a good yield of early fruits.

Crist (1) reported from Michigan that for greenhouse conditions, hardening the plants before setting did not give any beneficial results in the total or early yield of marketable tomato fruits; and Porter (7) of Connecticut reported somewhat similar results for field tomatoes under Connecticut conditions. However, potted plants were used in both these experiments, and the conditions under which they were grown were different from those usually experienced by most growers of early tomatoes in Mississippi. Bare-rooted plants, taken directly from the hotbed or greenhouse and set in the field, have not given satisfactory results for the early tomato crop at Mississippi State College. Notes taken from the planting of such plants over a period of several years at State College indicate that a high percent of mortality, or badly stunted plants, can be expected from the early spring setting of them in this locality.

When tender, bare-rooted hotbed plants were set out in the spring adjacent to slightly hardened potted plants of similar height, the time of fruit setting of the hotbed plants at State College has been from 2 to 3 weeks later than the potted ones. Plants grown in the cold frame, after being started in the hotbed, usually set fruit about 10 to 15 days earlier than succulent hotbed plants of the same height at time of setting. The one transplanting from the hotbed to cold frame or pots seems to be beneficial for later field setting due partially to root branching.

If tomatoes are grown for the early crop and a premium is paid for earliness, it often pays to pot the plants before time for field setting; but, if potting is not practiced, it usually pays to transfer the early plants from the hotbed to the cold frame before setting them in the field. Plants which are grown for the later crop may be seeded directly in the cold frame, but they must not be crowded in the bed if good stocky plants are to be produced.

The beginner in commercial tomato production will naturally want to know how many seed and how much hotbed and cold frame space to allow for each acre of tomatoes to be grown. If the plants are to be set 2 feet apart in the row, and the rows are to be 4 feet wide, it will require approximately 1½ ounces of seed and about 30 to 36 square feet of hotbed space (or two hotbed sashes) for each acre of tomatoes grown. This will require a cold frame 11 by 60 feet to grow the plants for an acre if the plants are set 4 by 4 inches in the cold frame. If the plants are set less than 2 feet apart in the row, perhaps 18 or 20 inches, which recent studies indicate are satisfactory planting distances, about 2 ounces of seed will need to be planted. The 2 ounces of seed can be planted under the two hotbed sashes, and the young plants can be set in the same cold frame by setting them 3 by 4 inches apart.

If the plants are to be potted instead of transferring them to the cold frame 6,000 pots will be required when the plants are set 2 by 4 feet in the field and 8,000 pots will be required if the plants are set 1½ by 4 feet. This will allow some extra plants to permit culling out of the poorer ones.

The seed may be sown broadcast or planted in rows 3 or 4 inches apart; but in either case the bed should be thoroughly watered before planting, and the seed covered lightly with sand or loose soil. It is usually better not to water the bed again until the seed begin to germinate, unless the bed begins to dry out too rapidly, and then water should be applied only in the forenoon of sunny days. Plants should be kept as dry as possible at night and on cloudy days. This helps to keep down diseases of seedlings.

Plants grown for the early market should be started in the hotbeds the latter part of January in central Mississippi and transferred to the cold frame or pots about the time the permanent leaves are beginning to develop, which is usually about 5 or 6 weeks after planting. They are then ready to be set in the field as soon as most of the danger of frost is over, which is usually about the first of April.

If the plants are grown for the late summer or fall crop, they can be planted directly in the cold frame about 6 weeks before time for setting in the field; but the seeds must not be planted as thickly if the plants are to be left in the bed until ready to set in the field. However, if the plants are to be potted, they may be planted thickly in the bed as for the early crop.

Time and Method of Setting Plants

Most commercial tomatoes in this State are produced for the early fresh market, and earliness is a most important factor. Therefore, the grower tries to have good stocky plants 8 or 10 inches high ready to set in the field as early in the spring as the danger of frost is over. This is usually the last week in March or first week in April through the central part of Mississippi. During some years tomatoes are set in the Copiah County area the third week in March, but more often they are set the fourth week in March and sometimes not until April. It is usually not safe to set tomato plants in the field north of Meridian and Jackson before late March or early April unless some kind of protection is given.

If "hot kaps" or some other plant protectors are used on a small number of plants, they may be set in the field a week or 10 days earlier. The "hot kaps" need to be used only on frosty or cool nights. If a late frost occurs after the plants are set, they may be covered with some other material if "hot kaps" are not available. Straw or leaves are sometimes used on a small scale. Commercial growers often cover the plants with soil; this is fairly satisfactory if the soil is not wet, but the covering and uncovering with wet soil often does more damage than a light frost would do to the plants. If wet or moist soil is used to cover the plants, they should not be uncovered until 3 or 4 o'clock in the afternoon, because when uncovered from moist soil in the forenoon, the midday sun is apt to kill a high percentage of the plants.

Fall tomatoes should be set in the field in central Mississippi about the first week in July. Some years, especially when rains occur frequently during the summer months, the plants set in the field earlier than July 1 become badly infected with leafspot, and the yield is greatly reduced. Plants set at State College after July 1 have not been damaged badly with this disease, especially if dipped before transplanting in a rather strong suspension of Yellow Cuprocide or some other "fixed" copper compound. Dipping the plants in a copper solution disinfects the leaves and stems, protecting the plants against leafspot until they become established in the field. The plants may be sprayed or dusted after being transplanted, but it is difficult and expensive to cover the foliage thoroughly by this method, while the dipping is an inexpensive method of application.

Plants set at State College as late as August 1, usually are killed by frost in the fall before maturing a high percentage of their fruits, and some years when an early frost occurs they are caught before maturing any of their fruits. This happened in 1943. Therefore, the first week in July appears to be the best transplanting date for fall tomatoes at State College and perhaps for most of the central part of the State. This would suggest a little earlier planting date for the northern part of the State, and perhaps later for the southern part.

A number of methods may be used in setting tomatoes, but the majority of commercial tomatoes grown in this State are set with hand trowels in bedded rows. The row should be prepared 10 or 15 days prior to planting time and preferably should be settled by a rain before setting the plants. Then, it is desirable to harrow the row at planting time and open it with some kind of small plow that will loosen the center of the bed to make transplanting easier, and at the same time will not make a deep furrow in the center of the row. A small shovel or "bull tongue" on a plow stock may be used, but some growers remove the moldboard from a small turn plow and use it with only the share.

Plants set early in the spring in a firm seedbed that has been thoroughly prepared seldom require watering. But if the weather is dry and warm and no rains occur after preparing the land, it may be necessary to water the plants even in the early spring. In all cases where the plants are watered, care must be taken not to pour water on the foliage because it is apt to wash the leaves into the soil, which usually results in death if the plant is exposed to the bright sun with mud on its leaves. Many of the leading growers make a practice of "muddying" the roots of bare-rooted plants immediately before setting them. This practice helps to supply the newly set plants with moisture until new roots can be formed. However, where this practice of "muddying" the roots is done, the operator must be careful not to get mud on the leaves, for the reason given above.

If potted plants or blocked plants (those taken with blocks of soil from the cold frame) are used, they seldom require watering early in the season, and often do not require watering later in the season. Bare-rooted plants, however, often require watering when set in warm weather even if the soil is moist; and they usually require watering when set in dry soil or loose soil regardless of the temperature.

When late tomatoes are grown in a loose sandy or sandy loam soil, it is preferable to set them deeply. This is especially true if the plants have long shanks and will lend themselves to deep transplanting in the late spring or summer season. Plants seem to stand the drought better if set deep, especially in a loose soil. If the soil is a heavy clay, deep transplanting is not recommended; the lower part of the stem does not develop roots freely in such soil, especially if heavy rains occur shortly after transplanting.

Spacing and Pruning

Severe pruning to one stem per plant and topping above the third cluster has been practiced in the Copiah County area for a number of years. This severe pruning was believed by the growers in that area to increase the early yields, but previous studies made by the U.S.D.A. Bureau of Plant Industry in cooperation with the Mississippi Experiment Station (4) indicated that this was not true. In these studies, plants pruned to one stem did not mature fruits earlier than those pruned to two stems, nor did topping the plants increase earliness.

It was observed during these earlier studies that topping at the third cluster greatly shortened the life of the plant; this was due principally to leaf diseases which killed the bottom leaves, and where the top leaves had been removed by topping there remained few or no leaves to support the plant. These leaf diseases start on the bottom leaves and work upward, killing most of the leaves as they go. The diseases work faster during rainy or moist weather, and sometimes kill the leaves below the third cluster before fruits on that cluster mature. If the plant is topped at the third cluster, the fruits on that cluster are picked from partially dead plants, resulting in poor quality fruit. When the fruits are exposed directly to the hot sun on such plants, a high percentage of them are damaged from "sunscald" and the grower is docked on quality as well as quantity.

If the tops are allowed to grow, however, new green leaves are continually being formed which function to help mature the fruits on the lower clusters. The growing top also gives some sun protection to the fruits; and if two stems are left instead of one, much more protection is provided. Tomato growers in certain areas practice staking the plants without pruning, and some of the home gardeners of this State make this practice.

Investigations have been conducted in other states on the pruning and staking of tomatoes and on the spacing of tomato plants. Some of the spacing work was done with unpruned and unstaked tomatoes and some with pruned and staked plants. Yields of pruned and staked tomatoes have been compared with yields of unpruned and unstaked plants, but in most cases only the total marketable fruits were reported and earliness was not given consideration. Earliness is a most important factor in commercial tomato production in this State, and was given due consideration in the studies herein reported.

Tomato Investigations

In 1939, investigations were initiated at State College and at the Truck Crops Branch Station at Crystal Springs to study the effect of spacing and pruning on the quality, earliness, and total yield of marketable fruit. This work was extended to the Delta Branch Station in 1942, and was continued at all three locations through 1943. However, the experiment

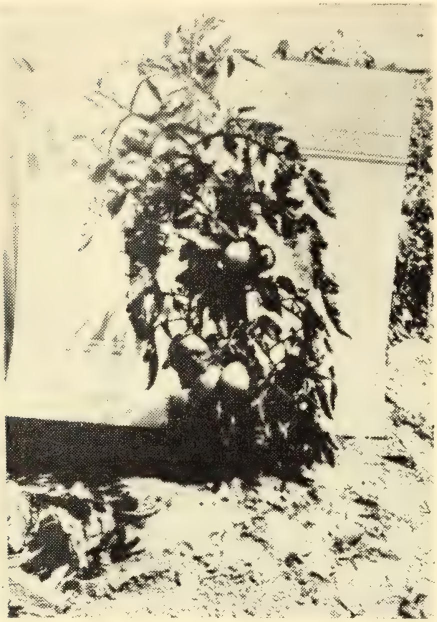

Figure 2. The Rutgers variety pruned to a single stem.

failed at Crystal Springs in 1942 and was ruined with nematodes at the Delta Station in 1943, so that this report includes 4 years of study at Crystal Springs, 1 year at Stoneville, and 5 years at State College.

The spacings studied were 12, 18, 24, and 30 inches between plants in the row, and plants pruned to one stem and staked for each of these spacings. In addition to these treatments, there was one with unpruned staked plants spaced 30 inches in the row, and another with staked plants pruned to two stems and spaced 24 inches in the row. The rows were 48 inches wide.

In 1941, a treatment of pruning to two stems and spacing 18 inches in the row was added to the State College test. Each treatment was repeated five times (occurring a total of six times) in each experiment, the plot arrangement being such that variability due to soil differences was reduced.

18-inch to 24-inch Spacing

Table 1 shows the total yields per acre of marketable fruit for each treatment for each of the 4 years at Crystal Springs and the treatment averages for these years. This table shows that on the average, there was an increased production per acre when the number of plants was increased as spacings were decreased. The differences between spacings for each of the 4 years were significant in practically all cases. The 12-inch spacing did not produce greater yields of total marketable fruit in 1939 than the 18-inch spacing with one stem, but did during each of the other 3 years. Data for the 4-year average show that greater yields of total marketable fruit were produced from the 12-inch spacing than from any of the wider spacings of one stem. Yields were increased as the number of plants per acre was increased, provided the

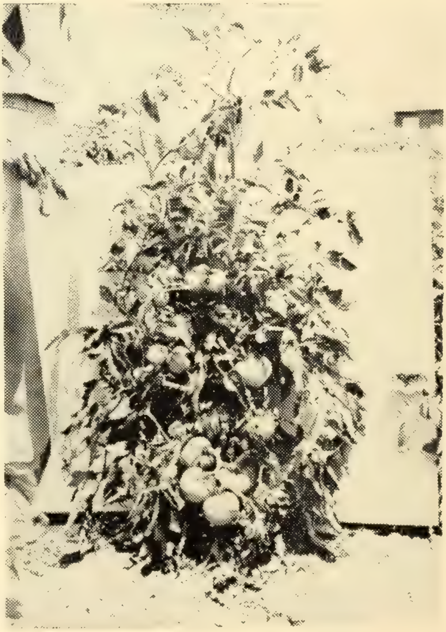

Figure 3. The Rutgers variety pruned to two stems (note the good protection of foliage on this plant).

plants were pruned to one stem and staked.

One or Two Stems Per Plant

The treatment with two stems per plant and 24-inch spacing produced consistently higher total yields of marketable fruit each of the 4 years than plants of one stem having the same spacing. Data of the 4-year average indicate that two stems are better than one stem at Crystal Springs. The data show that the treatment with unpruned but staked plants and 30-inch spacing yielded about as much total marketable fruit as the 24-inch spacing with two stems. However, the early harvests from the unpruned plants (as shown in table 3 from State College), was greatly reduced.

Table 2 shows the total yields of marketable fruit for each of the treatments and for each year from 1939 through 1943 at State College. It also shows the 5-year average for certain treatments and the 3-year average for all treatments. These results at State College follow the same trend as those described above for Crystal Springs. The closer spaced plants produced higher total yields of marketable fruit than wider spaced plants when pruned to one stem and staked.

Table 3 shows the early yields (first half of the pickings) at State College for each treatment by years and averages for all years. These data show that the early yields were also increased as the plants per acre were increased when pruned to a single stem. This table likewise shows that two stems were superior to one stem in the production of early fruits. This was true with both the 18-inch and the 24-inch spacings when each was compared with the single stems of the respective spacings. In other words, at each location two stems were better than one

Table 1. Effect of spacing and pruning on total yield (pounds per acre) of marketable tomatoes, Crystal Springs, 1939-1943.

Treatment	1939	1940	1941	1943	Average
12-inch (1 stem)	6,744	7,921	14,095	14,141	10,725
18-inch (1 stem)	6,953	6,102	10,227	11,730	8,753
24-inch (1 stem)	6,350	5,645	9,892	9,908	7,948
24-inch (2 stems)	7,600	6,793	10,222	11,962	9,144
30-inch (1 stem)	4,340	5,209	8,520	8,517	6,646
30-inch (no pruning)	7,699	5,542	11,795	11,140	9,044

Table 2. Effect of spacing and pruning on total yields (pounds per acre) of marketable tomatoes, State College, 1939-1943.

Treatment	1939	1940	1941	1942	1943	5-year average	3-year. av. (1941-43)
12-inch (1 stem)	22,072	9,345	9,574	28,165	13,368	16,505	17,035
18-inch (1 stem)	21,188	9,759	9,732	22,022	11,772	14,895	14,509
18-inch (2 stems)	——	——	9,754	29,242	15,844	——	18,280
24-inch (1 stem)	16,571	10,338	10,151	21,147	10,835	13,808	14,044
24-inch (2 stems)	20,125	11,097	9,354	25,535	14,472	16,116	16,454
30-inch (1 stem)	12,835	10,055	9,029	16,312	9,227	11,491	11,523
30-inch (no pruning)	15,601	9,717	8,767	30,607	12,210	15,380	17,195

Table 3. Effect of spacing and pruning on early yields (pounds per acre) of marketable tomatoes. State College, 1939-1943.

Treatment	1939	1940	1941	1942	1943	5-year average	3-year. av. (1941-43)
12-inch (1 stem)	13,525	5,154	5,449	11,350	6,265	8,348	7,689
18-inch (1 stem)	12,287	6,612	5,600	8,482	5,525	7,701	6,536
18-inch (2 stems)	——	——	4,745	9,072	7,131	——	6,983
24-inch (1 stem)	10,885	5,540	5,247	6,657	5,709	6,808	5,871
24-inch (2 stems)	10,087	6,257	4,721	7,540	6,404	7,002	6,333
30-inch (1 stem)	7,998	3,225	4,164	5,462	4,583	5,086	4,770
30-inch (no pruning)	7,360	5,031	4,001	3,652	4,260	4,861	3,971

stem, when spaced either 18 or 24 inches, in the production of both early and total marketable fruit.

No Pruning

The treatment with no pruning produced higher total yields than that with one stem and the same spacing (30 inches); and it also produced greater total yields of marketable fruit than some of the closer spaced pruned plants, but the early yields were reduced by this treatment (table 3), and it is not recommended in localities where earliness is of major importance.

Results of 1 year's study (1942) at the Delta Station show the same trend for the different treatments as results at the other two locations. Yields of the total marketable fruits for these treatments at this Station are as follows:

12-inch spacing (1 stem)	3,210 lbs.
18-inch spacing (1 stem)	1,750 lbs.
18-inch spacing (2 stems)	2,105 lbs.
24-inch spacing (1 stem)	1,213 lbs.
24-inch spacing (2 stems)	1,858 lbs.
30-inch spacing (1 stem)	1,170 lbs.
30-inch spacing (no pruning)	1,820 lbs.

Table 4 gives the cost per acre of production and marketing for each of the different treatments. These figures (taken from the cost levels at Crystal Springs in 1943) are based on $2 per day for labor, $2 per thousand for plants, $1 per thousand per year for stakes, and $2.30 per ton for harvesting and marketing the crop.

Profit from Various Treatments

Table 5 shows the 3-year average yields of the different treatments at State College. The yields were divided into early and late yields and each valued at the 3-year average price paid growers in Copiah County for the same period. These figures on prices were obtained from a buyer and shipper in 1934 and from a producer in 1941 and 1942 and are thought to be representative. The profits, or net income, listed in the last column of this table show that the treatment with 18-inch spacing and two stems would be most profitable under these cost and price conditions, and that the 24-inch spacing with two stems would be the next most profitable.

In table 6, the average yields of 1942 and 1943 are shown by weeks for each treatment, and the value of each week's harvest is based on the price paid for tomatoes by a Copiah County shipper during each of those weeks. The net income under these conditions for each treatment is shown in the last column of this table. The 18-inch spacing with two stems shows the highest profits, and 24-inch spacing with two stems the next highest, under these conditions, and the single stems with the wider spacings show the least profits. These latter treatments have been the ones used by a large number of growers in Copiah County in past years, and this has resulted in a great loss to the growers.

Table 4. Total cost of producing and harvesting an acre of tomatoes, Crystal Springs, 1943.

Treatment	Fixed cost[1]	Cost of plants	Cost of setting	Pruning and staking	Cost of stakes	Cost of harvest	Total cost
12-inch (1 stem)	$47.00	$22.00	$6.00	$31.00	$6.00	$19.61	$131.61
18-inch (1 stem)	47.00	15.00	4.00	21.00	4.00	16.69	107.69
18-inch (2 stems)	47.00	15.00	4.00	21.00	4.00	21.02	112.02
24-inch (1 stem)	47.00	11.00	3.00	15.00	3.00	16.15	95.15
24-inch (2 stems)	47.00	11.00	3.00	15.00	3.00	18.92	97.92
30-inch (1 stem)	47.00	9.00	2.50	12.00	2.50	13.25	86.25
30-inch (no pruning)	47.00	9.00	2.50	9.00	2.50	19.78	88.78

[1] The "fixed" costs include fertilizer, $27; land preparation, $4; three cultivations, $6; land rent and other incidentals, $10.

Table 5. Comparison of early and late yields in tons per acre and seasonal values for each treatment and computed profits.

Treatment	Early yield tons	Price received1/	Late yield tons	Price received2/	Gross income	Total cost	Net income
12-inch (1 stem)	3.845	$228.51	4.683	$167.23	$395.74	$131.61	$264.13
18-inch (1 stem)	3.268	194.22	3.987	142.38	336.60	107.69	228.91
18-inch (2 stems)	3.492	207.53	5.645	201.59	409.12	112.02	297.10
24-inch (1 stem)	2.936	174.49	4.086	145.91	320.40	95.15	225.25
24-inch (2 stems)	3.167	188.21	5.060	180.69	368.90	97.92	270.98
30-inch (1 stem)	2.385	141.74	3.377	120.59	262.33	86.25	176.08
30-inch (no pruning)	1.986	118.03	6.612	236.11	354.14	88.78	265.36

1/Prices of the early harvests were figured at $59.43 per ton.

2/Prices of the late harvests were figured at $35.71 per ton.

Table 6. Yield of marketable tomatoes by weeks at State College for 1942-1943 and profits computed accordingly.

Treatment	1st week		2d week		3d week		4th week		5th week		Gross income	Total cost	Net income
	tons	value	tons	value	tons	value	tons	value	tons	value			
12-inch (1 stem)	1.609	$151.81	2.171	$204.20	2.635	$205.66	1.650	$113.69	2.221	$ 74.94	$750.30	$131.61	$618.69
18-inch (1 stem)	1.132	106.80	2.142	201.48	1.516	118.32	1.800	124.02	2.377	80.20	630.82	107.69	523.13
18-inch (2 stems)	1.075	101.43	2.501	235.24	2.809	219.24	2.106	145.10	2.816	95.01	796.02	112.02	684.00
24-inch (1 stem)	1.357	128.03	1.741	163.76	1.225	95.61	1.533	105.62	2.352	79.36	572.38	95.15	477.23
24-inch (2 stems)	0.874	82.46	2.283	214.74	2.050	160.00	2.134	147.03	3.251	109.69	713.92	97.92	616.00
30-inch (1 stem)	0.902	85.10	1.309	123.12	1.348	105.21	1.226	84.47	1.683	56.78	454.68	86.25	368.43
30-inch (no pruning)	0.337	31.80	1.342	126.23	2.053	160.24	3.814	262.78	3.483	117.52	698.57	88.78	609.78

These figures on value of tomatoes of each week were obtained from a buyer and shipper in 1943, and they were as follows per ton: First week, $94.35; second week, $94.06; third week, $78.05; fourth week, $68.90; and fifth week, $33.74.

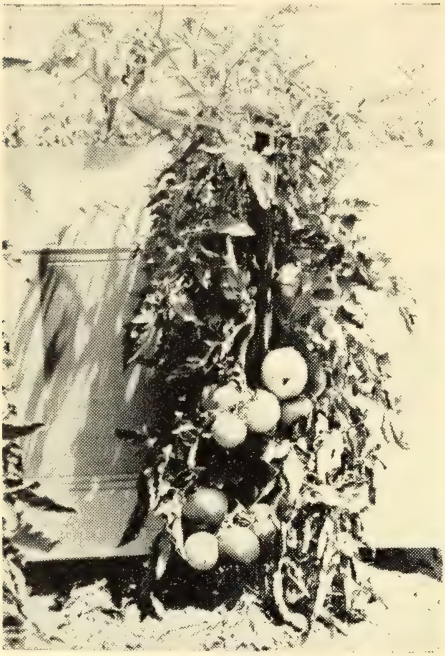

Figure 4. The Pan America pruned to two stems.

Results from these studies indicate that growers of early market tomatoes in Mississippi who plan to prune and stake their tomatoes would be wise to space the plants from 18 to 24 inches in the row and leave two stems per plant. This treatment greatly reduces injury from sunscald and increases the early and total yields of marketable fruits per acre over the old practice of pruning to a single stem and topping the plants above the third cluster.

No Staking or Pruning for Fall Tomatoes

Notes taken from observations made for several years at State College indicate that it is better not to prune or stake fall tomatoes in this locality. Plants on the ground seem to stand the hot dry weather of the late summer months better than plants tied to stakes. Under certain conditions in certain localities, it might be more economical not to prune or stake the later spring and summer tomatoes.

Varieties

There are a large number of tomato varieties and many of them have been grown to a limited extent in this State. For Mississippi conditions, tomatoes may be divided into fusarium wilt-resistant and wilt non-resistant varieties. Most of the so-called fusarium wilt-resistant varieties which have been on the market in past years are only partially resistant, and many of the plants in this group frequently fail because of this soil-borne disease. However, they are much superior to the non-resistant varieties on fusarium wilt-infested soils. When planted on a wilt-free soil, some of the non-resistant varieties are superior to many of the resistant ones in yield and quality of fruit.

During the past 5 years, a number of varieties have been tested at Crystal Spring, State College, and the Delta Station, for yield, eating quality, shipping quality, earliness, smoothness, and other factors. A number of these varieties were discarded from this test in 1941 and some

Table 7. Tomato varieties: yield in pounds of marketable fruits per acre, State College, 1939-1943.

Varieties	1939	1940	1941	1942	1943	5-year average	3-year. av. (1941-43)
Scarlet Dawn	8,865	8,880	7,107	18,160	10,529	10,708	11,932
Essary	——	——	5,980	23,360	10,869	——	13,403
Grothens Globe	6,681	10,399	4,658	——	——	——	——
Gulf State Market	9,143	10,146	6,041	19,720	10,060	11,022	11,940
John Baer	6,909	9,145	5,525	——	——	——	——
Rutgers	6,283	10,917	6,268	20,180	13,025	11,335	13,158
Louisiana Pink	4,330	8,556	4,388	——	——	——	——
Pritchard	7,798	9,789	6,369	——	——	——	——
Marglobe	6,198	7,410	6,155	20,940	10,544	10,250	12,546
Master Marglobe	6,647	11,976	5,269	20,300	10,879	11,014	12,149
Stokesdale	——	——	5,416	19,380	11,357	——	12,052

new ones added. Some were discarded because they produced low yields, some because the fruits were rough, and some because the eating quality was poor. Table 7 shows the yields per acre of marketable fruit for each year tested and the yearly average of those that were continued. Results at the other two locations were somewhat similar for these varieties. Grothen's Globe was discarded because it was a little late for the early market and the yields were not outstanding. John Baer, although a good early tomato for home use, is too soft for shipping, and Louisiana Pink and Pritchard have rather poor eating quality and are not outstanding in yields. Some other varieties which are not included in this table were discarded for these and other reasons.

Scarlet Dawn and Gulf State Market were the leading non-resistant varieties in yield and quality of fruit when grown in wilt-free soil. Gulf State Market is a little late for the early market, and plants have long internodes and grow rather tall for staking. Scarlet Dawn is early, has a fairly nice plant, and produces nice large fruit of good eating quality and good color.

Rutgers, Master Marglobe, Stokesdale, and Essary have been outstanding among the so-called wilt-resistant varieties in yield and other combined qualities

Stokesdale is earlier than any other varieties of this group, but it produces slightly smaller fruit than the others; however, this variety is rather prolific and has smooth oval-shaped fruit of fair color. It has been outstanding in the fall plantings at State College, grown without staking.

Plants of the **Rutgers** variety are large and stocky with short internodes and heavy, dark green foliage, which are desirable qualities for tomato plants that are to be pruned and staked. It usually produces large clusters of good size fruit, and the first three clusters, which are the most important, are produced fairly

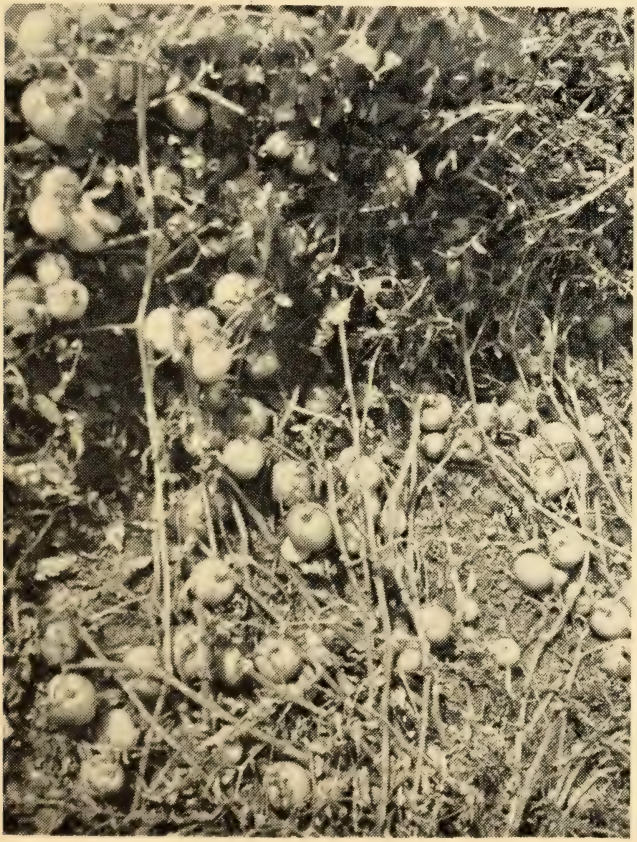

Figure 5. The Stokesdale variety grown in the fall of 1942 at State College and left on the ground without staking or pruning. Several pickings had been made when this picture was taken just after the first frost.

near the ground. This variety can be produced on much shorter stakes than many of the other varieties. The fruits have thick cell walls and stand up well in shipping. However, the fruits have rather large cores and the eating quality is not as good as Marglobe and some of the other tomatoes. This variety has become rather popular in Copiah County in recent years as a shipping tomato, and its yields in the tests have been among those of the top-ranking varieties. It usually gives higher yields in wilt-infested soils than Gulf State Market, and, since much of the soil in the trucking area is more or less infected with wilt, the Rutgers variety, since the beginning of these studies, has replaced Gulf State Market to a large extent.

Marglobe has been popular for a number of years and is still popular in many sections of the country, but it is not as well adapted to the climatic conditions of this State as it is to some other localities. The fruits do not color very well during the hot summer weather of this locality, and the yields are usually not as good as Rutgers. However, the eating quality of well-colored fruit is good and the coloring is usually much better in the fall. Therefore, it has been found to be a good fall tomato for this State.

Coloring of the **Essary** variety is none too good in this State, but some workers claim that this variety will hold up under unfavorable conditions better than most varieties. It is a fairly new variety, and has not yet gained wide popularity, but its yields in these studies have been satisfactory.

Pan America is a new fusarium wilt-resistant variety developed by the U. S. Department of Agriculture, and it has a much higher degree of resistance than the varieties listed in table 7. It produces a vigorous plant with good foliage, and many of the fruit have good color and good eating quality. However, the variety was released before its characters were well fixed, and seed obtained from some of the seed houses produce small fruit. This is highly objectionable and has resulted in lower marketable yields of this variety (grown from commercial seed) than from some of the standard varieties. However, some selections of individual plants of large smooth fruit have been made by the Mississippi Experiment Station, and one of these selections will probably be released at a future date. Yields of this selection appear to be favorable.

If tomatoes are to be grown on fusarium wilt-infested soil, a variety that has a high degree of resistance is to be preferred. However, if only small plantings of tomatoes are to be made each year on an average-size Mississippi farm, a rotation system can be practiced that will permit the non-resistant varieties to be grown with safety. If the tomato plantings are rotated on the farm land in such a manner that one planting is not closer than a couple of hundred feet from the location of a previous planting made within the past 6 or 8 years, there is not much danger of running into serious trouble with fusarium wilt. Care must be taken not to carry this and other diseases into the field on young tomato plants.

Scarlet Dawn is a good variety to grow for the early crop if wilt is not present, and it can be successfully grown under the conditions described above.

Control of Insects on Tomatoes

Only a few insects usually require control on tomatoes in Mississippi, although several others may occasionally cause injury. The most important are the tomato fruitworm and tomato hornworm. Others of less importance or less frequent occurrence are the Colorado potato beetle, vegetable weevil, blister beetles, cut worms, stink bugs, and fleabeetles.

Tomato fruitworm. This insect, also known as the corn earworm and the cotton bollworm, destroys tomatoes of all sizes, from those just formed to ripening fruits; a single worm often moving from fruit to fruit and ruining several before becoming fully grown. Control by dusting with calcium arsenate or cryolite at weekly or 10-day intervals after blooming begins, continuing until the fruits are half grown in commercial plantings, or until almost mature in home gardens where the fruits will be washed or wiped before eaten. If spraying is preferred, use 3 tablespoons cryolite in a gallon of water, or 3 pounds in 50 gallons water.

At the Truck Crops Experiment Station, Crystal Springs, a mixture of 1 pound cryolite and 9 or 10 pounds corn meal placed in pinches on the buds or scattered over the plants has given about the same control as calcium arsenate or cryolite and is cheaper, but is not effective against hornworms which are controlled by the dusts.

Tomato hornworms. Two of these large green horned worms, both of which also feed on tobacco, are common in Mississippi. They do not feed on fruits but rapidly destroy the leaves and buds. Calcium arsenate or cryolite dusts or sprays for the fruitworm will control these also. Hand-picking is practical in small gardens.

Colorado potato beetle. This beetle and its brick-red grubs may often cause serious injury to young tomato plants soon after transplanting. Dusting with calcium arsenate or cryolite will kill them quickly. Calcium arsenate is cheaper but the cryolite may give better protection if fleabeetles are also present.

Vegetable weevil. This is chiefy a pest of the tomato plant grower as it does most damage in hotbeds and cold frames in early spring. The weevil and its dirty-greenish grub about half an inch long are both most active at night or in dark

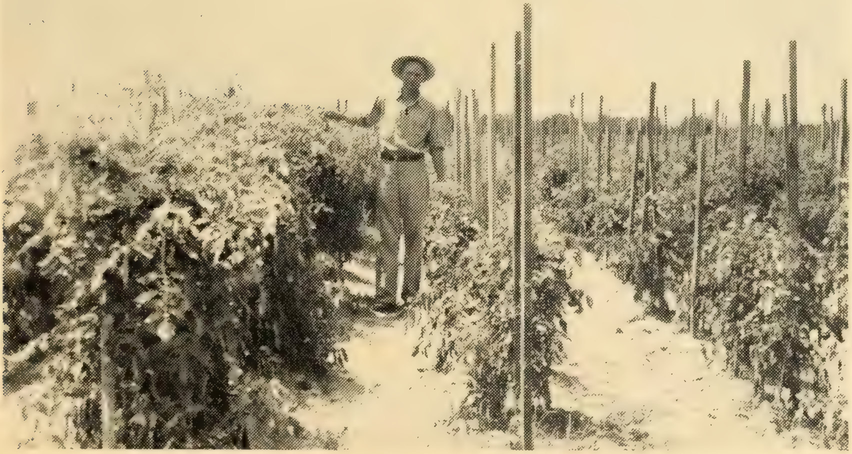

Figure 6. A planting of tomatoes on the right practically ruined with nematodes. The pests were carried to the field on the plants grown in an infested bed where sweet-potatoes were bedded the previous year.

corners and can soon destroy large numbers of plants. When noticed, spray beds or frames thoroughly with 6 teaspoons lead arsenate in 1 gallon water, hitting stems and undersides of leaves.

Blister beetles. The southern striped blister beetle, a brown species with black stripes, is most common in Mississippi, but other species may often be present on tomatoes. Shaking into shallow pans of kerosene or dusting with a mixture of one part cryolite and three parts talc or flour may be effective in many cases, but if large numbers are overrunning a garden, usually the most practical control is to drive the beetles into hay or straw piled at the edge of the garden and burn them.

Cutworms. When the garden or tomato patch is plowed in winter and is kept free of vegetation until plants are set out. cutworms are not likely to cause trouble If a winter cover crop is turned under only a week or two before planting it will be well to use poisoned bait before setting out plants. Mix 8 tablespoons Paris green or white arsenic in 5 pounds dry wheat bran, then slowly add enough water to make thoroughly moist but not sloppy. Scatter broadcast in late afternoon.

Stink bugs. Flat green or brown stink bugs and longer plant bugs may often cluster in numbers on tomatoes and cause considerable damage by sucking the fruits. They are resistant to sprays and dusts, and hand-picking or shaking quickly into a pan of kerosene before they fall or fly away are about the only controls of any value.

Fleabeetles. These attack the young plants just after setting them out. If the garden has been well cultivated and kept free of weeds, fleabeetles are usually not so numerous as in weedy locations. Dipping or spraying the plants

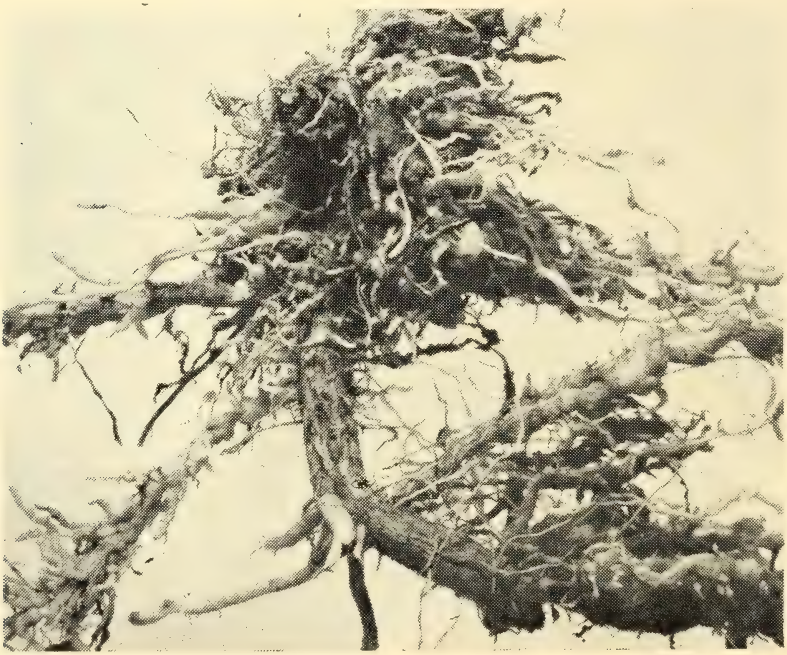

Figure 7. Root-knot nematode damage to tomato roots (variety Pan America). This plant threatened to produce fruit, its owner wasting many gallons of water. time, and fertilizer on it, hopefully waiting for a crop that was never produced.

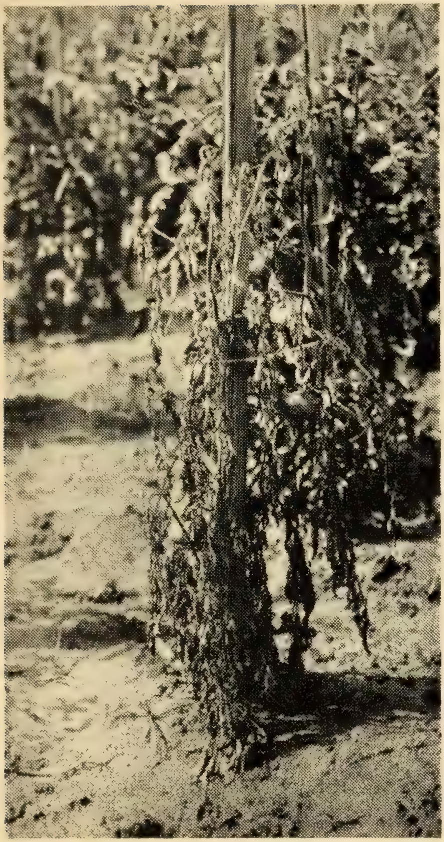

Figure 8. Typical symptoms of fusarium wilt on tomatoes.

with bordeaux mixture containing 6 teaspoons lead or calcium arsenate per gallon, or dusting thoroughly with cryolite. should give good results.

The foregoing discussion of insects on tomatoes was prepared by Dr. Clay Lyle, entomologist for the Mississippi Station

Control of Tomato Diseases

There are three major diseases of tomatoes in the mid-south area. Any one of these diseases may cause crop failure, or a combination of several diseases may render tomato production unprofitable. Once certain of these diseases become established in a soil, it may never be profitable to use it for tomatoes again.

Use certified seed whenever possible. All certified seed are produced from plants assured of being practically free from diseases. Certified seed have been treated with a fungicide to help prevent damping-off and collar rot and do not require additional treatment.

Root-knot nematode (figures 6 and 7). This is one of the most common and most destructive diseases of tomatoes in the mid-south area. The disease-producing agent is carried in soils. If present in hot bed or cold frame soils the disease may be carried to the field on roots of young plants and an entire field may be ruined, not only for tomatoes, but for nearly all warm season vegetables. The root-knot nematode attacks the roots of more than a thousand kinds of plants causing their roots to rot. No varieties of tomatoes are known to be resistant. Soil treatments with chemicals are costly. Prevention is the only practical method of dealing with this disease. Learn to identify it by the large cancerous decayed roots and avoid spreading these infested plants and soils. Fields known to be infested should be planted to grain crops and bare-fallowed in the months of July and August. Permit no weeds to grow during this period. Experiment Station Circular No. 104 contains additional information about this serious soilborne disease.

Fusarium wilt (figure 8). This fungus parasite causes tomato plants to wilt and die. It is similar to cotton wilt and it is usually most common in sandy soils. The Pan America variety of tomato is almost immune to fusarium wilt, while Rutgers, Marglobe, and certain other varieties are somewhat resistant. A long-time rotation and the use of resistant varieties have proved quite satisfactory for the control of this disease.

Leaf spot. Small decayed spots appear on the lower leaves; these leaves later turn yellow and become useless; the disease

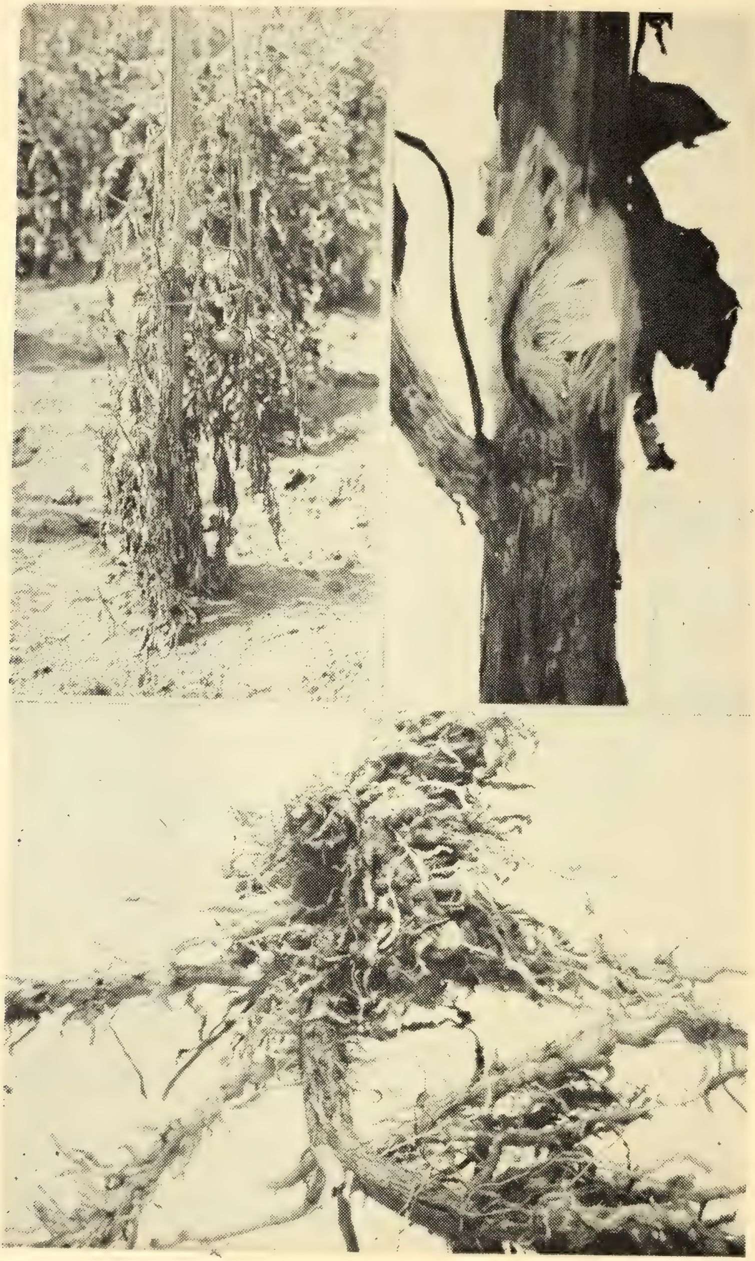

Figure 9. Upper left, tomato fusarium wilt; upper right, Southern stem-blight (common on many plants); lower, root-knot nematode on Pan America tomato roots, a fusarium wilt resistant variety.

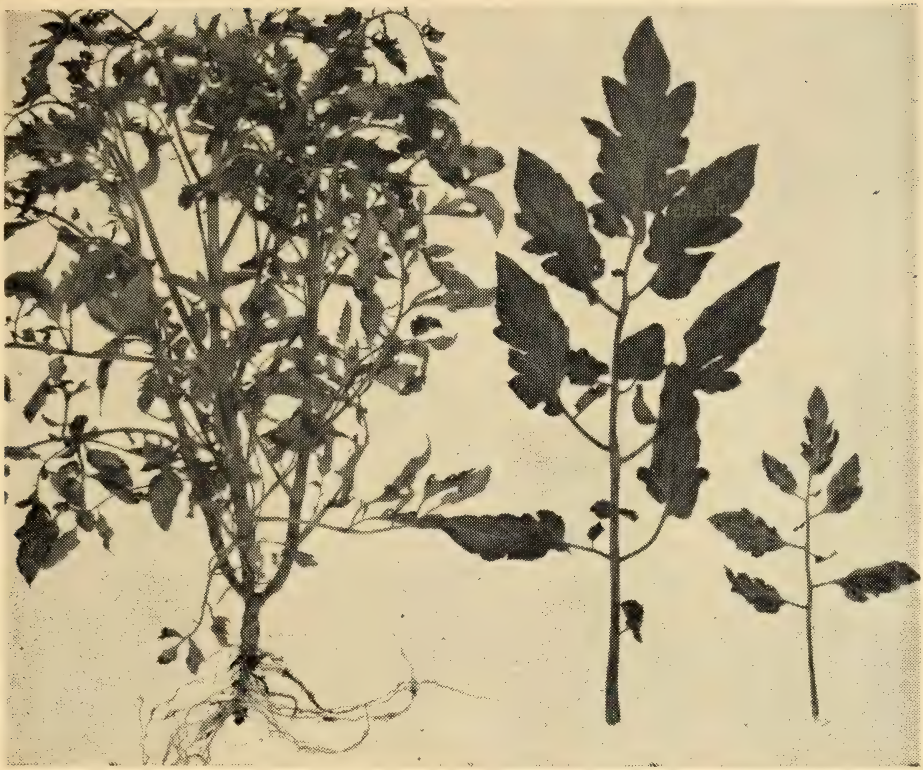

Figure 10. Tomato mosaic. Normal healthy leaf in center, stunted virus affected plant on left. Diseased leaf on right.

progresses up the plant, causing defoliation and stunting. Control methods consist of applying sufficient fertilizer to maintain vigorous growth, use of certified seed, spraying or dusting young plants in the cold frame with one of the "fixed" copper compounds, and spraying or dusting with a "fixed" copper fungicide in the field. These fungicides, and directions for their use, may be obtained from the larger seed houses in Mississippi.

Bacterial wilt (figure 9). This disease is very similar in appearance to fusarium wilt of tomato. If a stem is cut open, it is usually hollow, rotten, and watery. Fusarium wilt does not cause this type of stem symptom. There are no known practical methods of controlling this disease. It will live in sandy soils for at least 25 years. This disease is common in the Southeastern States and it is spread to new areas in the soil and in roots of young plants. Never use uncertified uninspected plants lest this disease be carried to the premises.

Mosaic virus (figure 10). Tomato mosaic is caused by a virus which is easily spread from plant to plant when setting, pruning, or handling. The leaves assume a mottled yellowish-green pattern which resembles a mosaic design. Young plants are stunted severely and never grow properly. The disease is extremely infectious. By simply rubbing a diseased leaf between thumb and finger, then rubbing a young leaf of a healthy plant through the same fingers will cause the disease to reappear in the healthy plant in about two or three weeks. The infectious material can be removed from the hands by washing with strong soap. One should never handle mosaic-infected plants except to destroy them. Avoid using tobacco when working with young plants because the virus is present to some degree in nearly all forms of tobacco. Strong soap will destroy the infectious virus on the hands.

The foregoing discussion of tomato diseases was prepared by Dr. J. A. Pinckard, plant pathologist for the Mississippi Station.

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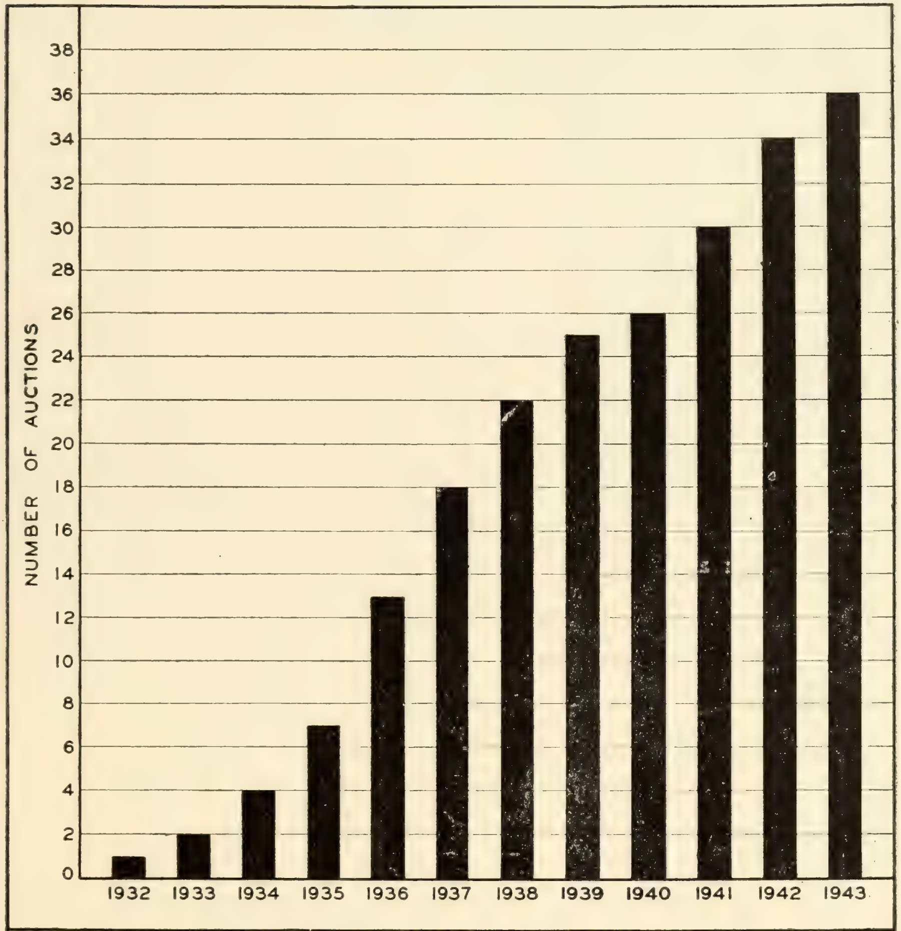
LIVESTOCK AUCTIONS
IN MISSISSIPPI



LIVESTOCK AUCTIONS HAVE DEVELOPED RAPIDLY IN MISSISSIPPI

MISSISSIPPI STATE COLLEGE
MISSISSIPPI AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

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Special thanks are extended to the General Education Board for supplementary funds used in the conduct of this project as well as other funds that are making possible the development of a comprehensive marketing research program for the State.

LIVESTOCK AUCTIONS IN MISSISSIPPI

by

D. W. PARVIN

Associate Agricultural Economist

During the past decade, cotton has become less important and livestock more important in the agricultural economy of the State. Many leaders in the field of agriculture feel that cotton will become even less important after the war due to the competition of foreign cotton and synthetic fibers. For this reason, farm leaders in Mississippi and the South have been looking for enterprises to off-set the anticipated decline in the value of cotton sales. Commercial production of livestock and livestock products is thought by many to fulfill this need.

Even though the increased competition to cotton production should fail to materialize and the production of cotton in the State should continue at about the same level, it would still be wise for farmers to increase their livestock enterprises so as to better utilize their labor throughout the year and in that way increase their total income.

The one-crop system of farming as practiced by most farmers in Mississippi results in the labor force being overworked a few months of the year and being more or less idle the balance of the year. Paul S. McComas and Frank J. Welch in their bulletin on farm labor requirements in Mississippi, showed that about five to six times as much work was performed on Mississippi farms in May, September, and October as in December, January, and February.[1]

The farmer should no more expect to make a good living by working part of the year than should the factory worker, and everyone knows what happens to the standard of living of the factory worker when he is "laid off" for a few months. Farm management studies have shown that farmers with livestock enterprises in addition to cotton made more money than farmers depending on cotton alone. The addition of livestock enterprises allowed these farmers to increase their income by furnishing profitable employment during seasons in which they would be idle under the old system of one cash enterprise. Part of the increased income accruing to farmers with livestock enterprises can be attributed to the increased fertility of the soil resulting from the application of manure.

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[1] McComas, Paul S., and Welch, Frank J., **Farm Labor Requirements in Mississippi,** Mississippi Experiment Station Bulletin Number 387, 1943, p. 1.

Objectives and Method of Study

This project is one of a series of studies dealing with the various marketing problems in Mississippi and growing out of the recent over-all study of farm production and marketing systems and facilities.[2] The study of farm production and marketing systems and facilities indicated that the problems connected with marketing livestock were as serious as those connected with the marketing of any other farm commodity and that auction markets were practically the only organized livestock markets in Mississippi. This study was conducted for the purpose of furnishing information that will help in the further development of a sound livestock marketing system. The study was started in the fall of 1943.

Briefly stated, the following objectives were set up to guide the course of study:

1. To study the development of livestock auctions in the State.

2. To determine the relative importance of auctions

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[2] Miley, D. Gray, **Commercial Farm Production and Agricultural Marketing Systems and Facilities in Mississippi,** Mississippi Experiment Station Bulletin Number 394, 1943.

in the marketing of Mississippi's livestock.

3. To make an economic analysis of livestock auctions with regard to (a) their organization, (b) the practices followed in buying and selling livestock, (c) the kind of livestock handled and the prices received by consignors, and (d) their receipts and expenses.

4. To determine the attitude of farmers toward auctions.

5. To analyze the basic problems in selling livestock through auctions and to point out possible solutions.

All 37 auctions in operation in Mississippi as of November 1, 1943, were visited in October and November of the same year and complete schedules concerning volume of business, facilities, plant organization, and operating methods were obtained from 32 operators. Data concerning the volume of business were obtained from the remaining five operators. From January 1, 1943, to October 1, 1943, five auctions ceased operation. Data concerning their volume of business were obtained by the use of mail questionnaires.

The 30 auctions operating all of 1943, for which complete schedules were obtained, were divided into small, medium, and large auctions on the basis of the total value of sales in order to study the economic effectiveness of each size group. The 10 with annual sales of less than $200,000 were classified as small, the 10 with annual sales of from $200,000 to $750,000 as medium, and the 10 with annual sales of over $750,000 as large.

Prices at which animals actually sold in 1943 were tabulated from records at five large, three medium, and five small auctions. In tabulating prices only one sales day was used each month; the sale that was held closest to the fifteenth of the month, if possible. The prices of all animals sold on that particular sales day, for which the records showed kind and class, were tabulated. Some auctions had to be omitted from the sample because their records did not show the kind and class of livestock sold; others had to be omitted because they either kept no records or else kept them for less than one year. However, the sample of auctions from which price data were obtained is representative of the group as a whole.

Income and expense data were obtained from the records of two large, two medium, and three small auctions. A larger sample was impractical due to the fact that many auction operators either kept no records of receipts and expenses or else combined them with that of their other business or businesses.

In January 1944, 50 questionnaires relative to the attitude of farmers toward auctions and where they market their livestock, were mailed to each of 143 of the 216 white and 75 of the 116 colored Vocational Agriculture teachers in the State with the request that they give one to each of their vocational agricultural students. Each student was requested to carry the questionnaire home and help his father fill it out with data concerning his farm. Schedules were sent to not more than two white and two colored Vocational Agriculture teachers in each of the 76 counties having vocational agriculture schools; returns were secured from 44 counties. Questionnaires were returned by 44, or 31 percent of the white Vocational Agriculture teachers and by 12, or 16 percent of the colored Vocational Agriculture teachers. A total of 951 questionnaires were returned, of which all or part of 929 were usable.

Data relative to laws and regulations governing auctions in other states were obtained from the State Department of Agriculture or some similar agency of 46 of the other 47 states.

In addition to this information, data were obtained from books, Experiment Station bulletins, and various publications of the United States Department of Agriculture.

The Importance of and the Trends in Livestock Production in Mississippi

The total value of all farm products sold or traded amounted to $115,353,273 in 1939, according to the 1940 census. Of this total, $17,023,874 or 14.8 percent was contributed by livestock and livestock products. In other words, about one out of every seven dollars accruing to Mississippi farmers came from livestock and livestock products. Dairy products made the greatest contribution to the value of livestock and livestock products sold or traded. Of the $17,023,874 of livestock and livestock products sold or traded, dairy products contributed $7,133,306; animals sold or traded contributed $6,588,145.

The total value of livestock and livestock products, the total value of all farm products sold or traded, and the value of cotton and cottonseed harvested were compared for 1929 and 1939 in order to determine the shifts in production during that period. When the 1929 values were adjusted to 1939 level in order to make the two sets of figures comparable, it was found that the total value of farm products sold or traded decreased 6.6 percent, or from $123,447,673 in 1929 to $115,353,273 in 1939. During the same period, the value of livestock and livestock products sold or traded increased 32 percent, or from $12,900,850 to $17,023,874 and the value of cotton and cottonseed harvested decreased 14.6 percent, or from $105,574,355 to $90,116,356. The total value of livestock and livestock products sold or traded amounted to 14.8 percent of all farm products sold or traded in 1939 as compared to 10.5 percent in 1929.

During the past three-quarters of a century, livestock production in Mississippi has increased at times and decreased at others. The number of livestock kept on farms ran in cycles, and this was especially true of hogs. For this reason, the average number of livestock on farms was calculated for the past seven decades in order to eliminate the effects of the cycle's fluctuations in so far as possible and in this way to determine the general trend in livestock production.

The number of animal units on farms in Mississippi increased from decade to decade from the 1870's through the 1930's, with one exception; the number on farms was about three percent higher in the decade from 1910 through 1919 than in the 1920's. The increased demand for livestock products during World War I probably accounts for this one exception. Since 1940, livestock production in Mississippi has increased considerably due to the pressure exerted by the war in the form of demands for concentrated foods to feed our soldiers and ship to our allies. See table 1.

Cattle accounts for the increased importance of livestock in Mississippi. The average number of cattle on farms increased consistently from decade to decade, whereas the average number of sheep and hogs either decreased or showed no consistent movement. The number of sheep on farms increased through the 1890's and decreased each decade after that. Hogs on farms decreased from the 1870's to the 1880's, increased each decade from the 1880's to the decade from 1910 through 1919, and then decreased during the 1920's and 1930's. The number of hogs on

Table 1. Average number of livestock on farms in Mississippi, by decades, January 1, 1867-1944

Period	All cattle	Sheep and lambs	Hogs and pigs	Animal units[1]
		thousands		
1867-1869	577	317	1028	552
1870-1879	683	242	1059	619
1880-1889	839	328	944	716
1890-1899	850	329	1164	753
1900-1909	908	212	1108	773
1910-1919	1032	170	1203	864
1920-1929	1040	120	966	834
1930-1939	1223	84	956	951
1940-1944	1363	70	1129	1066

Source: **Livestock on Farms**, January 1, 1867-1935, B. A. E., U. S. D. A., and **Livestock Reports**, January 1, 1936-1944, B. A. E., U. S. D. A.

[1] An animal unit is a mature cow or bull or the equivalent in other livestock. Two calves or heifers, 7 sheep, 14 lambs, 5 hogs and 10 pigs are the number of each usually considered to be an animal unit. Since the calves, lambs, and pigs were not given separate from the mature animals, it was assumed that half of the animals in each group could be classified as mature and that 1.5 head of cattle, 7.5 head of hogs and pigs, and 10.5 head of sheep and lambs would equal one animal unit.

farms was lower during the 1930's than any other decade except the 1880's. There were about twice as many cattle, about one-third as many sheep, and about nine-tenths as many hogs on farms in Mississippi during the 1930's as during the 1870's.

The data discussed above and summarized in table 1 permits the making of the following rather definite statements: (1) the trend in the production of cattle is upward; (2) the trend in the production of sheep is downward; (3) there is no consistent trend in the production of hogs; however, the production of hogs seems to be just about holding its own or possibly decreasing slightly; and (4) the trend in the production of all livestock is upward, due to the increasing importance of cattle on Mississippi farms.

The commercial production of livestock and livestock products is concentrated in the Black Prairie (including Oktibbeha County) and the Brown Loam (including Copiah County) Areas of the State. Lightest commercial production is found in the Delta, the Gulf Coastal, and the Lower Coastal Plain Areas. See table 2.

The commercial production of cattle is most concentrated in the Black Prairie (including Oktibbeha County) and the Brown Loam (including Copiah County), and least concentrated in the Delta, Lower Coastal Plain, and Gulf

Coastal Areas. Dairy production is concentrated in Oktibbeha County and the Black Prairie Areas, and beef production in the Brown Loam (including Copiah County) and the Black Prairie (including Oktibbeha County) Areas of the State. See table 3. Although the commercial production of hogs is not highly important in Mississippi, the heaviest concentration is found in the Black Prairie, Delta, and Brown Loam Areas of the State. The Lower Coastal Plain and Gulf Coastal Areas are the only areas in which the commercial production of sheep is of any importance.

Table 2. Number of livestock sold per 1,000 acres of land, by type-of-farming area, Mississippi, 1939[1]

Area	Cattle	Calves	All cattle	Hogs and pigs	Sheep and lambs	Total anim'l units[2]
Delta	2.45	0.87	3.32	8.43	0.22	4.03
Brown Loam	6.07	5.21	11.28	7.07	0.39	9.65
Clay Hills	5.20	3.54	8.74	6.32	0.08	7.86
Oktibbeha	9.10	7.16	16.26	8.03	0.89	13.84
Black Prairie	8.14	4.51	12.65	10.35	0.68	11.84
Copiah	6.08	6.34	12.42	2.28	....	9.55
Upper Coastal Plains	4.62	3.47	8.09	6.83	0.03	7.27
Longleaf Pine	4.87	2.91	7.78	3.98	0.20	6.87
Lower Coast'l Plains	2.42	1.45	3.87	4.11	6.01	4.27
Gulf Coastal	2.11	1.82	3.93	4.45	5.95	4.18
State	4.91	3.43	8.34	6.47	0.94	7.58

Source: Compiled from data taken from the 16th Census of United States Agriculture, first and second series.

[1] All land was used instead of land in farms because of the wide variation in the proportion of land in farms between the different areas.

[2] See footnote to table 1.

Marketing Facilities Available

On November 1, 1943, there were 37 livestock auctions operating in Mississippi. These auctions are located in 29 counties and at least 1 is located in each type-of-farming area except the Gulf Coastal Area which comprises Hancock, Harrison, and Jackson Counties.

According to a recent study, there are about 1,600 livestock dealers or truck buyers in Mississippi. This is an average of about 20 per county; however, there are as many as 60 in some counties.

Table 3. Number of livestock per 1,000 acres of land, by type-of-farming areas, Mississippi, 1940[1]

Area	Cows and heifers milked	Cows and heifers kept mainly for beef production
Delta	10.1	1.7
Brown Loam	16.3	7.7
Clay Hills	16.3	1.7
Oktibbeha	55.9	4.4
Black Prairie	30.4	6.8
Copiah	16.5	11.0
Upper Coastal Plains	16.0	1.9
Longleaf Pine	12.5	3.6
Lower Coastal Plains	5.2	4.4
Gulf Coastal	3.9	4.5
State	15.0	4.1

Source: Compiled from data taken from the 16th Census of United States Agriculture, first and second series.

[1] See footnote 1 to table 2.

The Union Stockyards at Jackson is the only terminal public market in the State. No commission firms operate at this market. Livestock is bought by the company operating the stockyard on a grade basis all sales days of the year. The operators of this market are order buyers and ship most of their purchases out of the State. Terminal public markets, such as Memphis and New Orleans, located in nearby states, serve the livestock producers of Mississippi, especially those in adjacent areas.

In addition to the market outlets mentioned above, there are 2 packing plants, 35 local slaughterers, and 372 butchers in Mississippi to which livestock producers sometimes sell direct. Plants slaughtering over 5,000,000 pounds (dressed weight) were classified as packing plants, those slaughtering from 200,000 to 2,000,000 were classified as local slaughterers, and those slaughtering from 10,000 to 200,000 pounds were classified as butchers.

The place the auction market assumes in the livestock marketing system as a whole is dependent on who consigns and who buys the livestock. That is, the auction may be the only agency handling the livestock as it passes from the producer to the final purchaser, or it may be one of several agencies handling the livestock. For example, some livestock is consigned by farmers and bought by other farmers for further feeding or by slaughter establishments; on the other hand, livestock sometimes goes from the producer to a local dealer, from the local dealer to an auction, from the auction to a shipper, from the shipper to a public terminal market, and from the terminal public market to a packing plant in the case of slaughter animals or back down through the same type of agencies to farmer buyers in the case of feeder, stocker, and breeding animals. However, it must be pointed out that only a part of the livestock follows these two channels to its final purchaser and that some livestock is sold directly to its final purchaser by each of the agencies mentioned above.

DEVELOPMENT OF LIVESTOCK AUCTIONS IN MISSISSIPPI

The development of livestock auctions in Mississippi has been rapid. The first auction to begin operation in Mississippi of which any record is available, was organized in 1932. Since that time, at least one additional auction has begun operation each year, with 1936 and 1937 being the 2 years in which the development of auctions was most concentrated. Almost one-third of the 37 auctions operating November 1, 1943, were organized in these 2 years. An additional one-fourth of the auctions have been organized since January 1, 1941. In general the large and medium auctions were organized at earlier dates than the small auctions. See table 4.

Table 4. Date of organization of auctions now operating in Mississippi

Year	10 small auctions	10 medium auctions	10 large auctions	36 auctions[1]	
	number	number	number	number	percent
1932			1	1	2.8
1933		1		1	2.8
1934			1	2	5.6
1935	1	1	1	3	8.3
1936	1	2	2	6	16.7
1937		4		5	13.9
1938	1		3	4	11.1
1939	3			3	8.3
1940			1	1	2.8
1941	2	1	1	4	11.1
1942	2	1		4	11.1
1943				2	5.6
Total	10	10	10	36	100.1

Source: Survey of auction operators.

[1] All auctions operating in Mississippi as of November 1, 1943, except one.

Auctions have been established in areas that were already adequately served by auctions, with the result that a number have had to discontinue operation. Also, the organization of auctions by individuals who either lacked the ability or financial backing to successfully operate them has contributed to the number that were organized, operated for a short time, and then went out of business. This statement is substantiated by the fact that successful auctions are now operating in towns where auctions had failed previously. Five, or about one out of every eight auctions operating in Mississippi on January 1, 1943, discontinued operation during the year.

Dealers were the leading promoters of auctions. Two out of every five auctions were organized by dealers. The remainder were organized by towns, farmers, businessmen cooperatives of farmers, and operators of other auctions. Five of the small, two of the medium, and six of the large auctions were promoted by traders. One medium and three small auctions were promoted by towns. See table 5.

Table 5. Promoters of auctions, 32 auctions, Mississippi, 1943

Promoters	10 small auctions	10 medium auctions	10 large auctions	32 auctions	
	number	number	number	number	percent
Dealers	5	2	6	13	40.6
Towns	3	1		4	12.5
Farmers	1	1	2	4	12.5
Businessmen		3	1	4	12.5
Cooperatives of farmers	1		1	3	9.4
Operators of other auctions		3		4	12.5
Total	10	10	10	32	100.0

Source: Survey of auction operators.

The promoting of auctions by towns has met with failure in several instances because they were organized in order to draw trade to the town without determining whether or not they were needed. Towns with auctions have the advantage over nearby towns without auctions because farmers in many instances will take the money received for livestock and buy their supplies at that town on the same day in order to save another trip. Businessmen in other towns soon noticed this and began to agitate for a local auction. In addition to auction facilities actually built by towns, several auctions organized by dealers were financed by funds lent by local businessmen or banks for the reason mentioned above. Eventually, those auctions that have been organized in areas where the territory they can draw from is too small, will be forced out of business. This has already happened in many instances.

Profit was the most important motive given by promoters for developing auctions. Thirteen, or 41 percent of the operators, reported that their auction was organized for the profit received. Other important reasons given for the organizing of auctions and the percentage giving each reason are: Farmers wanted outlet for livestock, 15.6 percent; businessmen wanted to draw trade to town, 12.5 percent; operator saw the need for local auction, 9.4 percent; and operator wanted to draw trade to mule barn, 6.3 percent.

All auctions in the State except one are privately operated. This auction is owned and operated by a town in connection with its fair and livestock show, and all profits are used to improve facilities. Several of the other auction barns are cooperatively owned by farmers or towns but have been leased to individuals who operate them as private businesses. The plant at one large auction is owned by a corporation which leases it to one of the members who operates the auction as a private business.

One-half the auctions are operated by partnerships and one-half by individuals. The partnerships varied from two to four members, the majority having two. A larger proportion of small auctions were operated by individuals than was the case for medium and large auctions. See table 6.

The operation of an auction is a part-time business with most operators. Three-fourths of the operators reported that they were engaged in one or more businesses in addition to operating their auction. Farming was the additional business or occupation reported most often by auction operators. Packing plant operators, bankers, dairy retailers, ginners, auctioneers, butchers, merchants, sheriffs, and sawmill operators were other businesses or occupations reported. Eight operators reported that they were not engaged in any other business. More small operators were engaged in farming than was the case for medium and large operators. Buying and selling livestock during the week was not considered as a separate occupation since most operators stated that they did this as a regular part of their auction business.

Table 6. Organization of auctions, 37 auctions, Mississippi, 1943[1]

Type of organization	10 small auctions	10 medium auctions	10 large auctions	37 auctions	
	number	number	number	number	percent
Single individual	6	3	5	18	48.6
Partnership	3	7	5	18	48.6
Cooperative	1			1	2.7
Total	10	10	10	37	100.0

Source: Survey of auction operators.

[1] All auctions operating in Mississippi as of November 1, 1943.

There are three types of auctions in Mississippi, the most numerous of which is the general purpose auction. Twenty, or 62.5 percent of the 32 auctions studied, fell within this classification. In addition to livestock and workstock, these auctions sell practically any type of produce or merchandise assigned to them. Second-hand machinery is probably the most important of these miscellaneous items sold. However, livestock makes up the bulk of sales at all these auctions. The livestock-mule auction was the second most important type of auction in the State, with nine auctions falling within this classification. These auctions sell livestock and workstock, with livestock making up the bulk of the sales. The third and least numerous type of auction was the straight livestock auction which sells nothing but livestock. There were 3 auctions of this type in the 32 studied. For obvious reasons a larger proportion of the small auctions was of the general purpose type than was true of medium and large auctions. See table 7.

In order to determine the importance of auctions in the livestock marketing system of Mississippi each of the 42 auction operators who operated all or part of 1943 was requested to estimate the number of animals they

Table 7. Types of auctions, 32 auctions, Mississippi, 1943

Type of auction	10 small auctions	10 medium auctions	10 large auctions	32 auctions	
	number	number	number	number	percent
Livestock		1	2	3	9.4
Livestock-mule	2	2	3	9	28.1
Livestock-mule-miscellaneous	8	7	5	20	62.5
Total	10	10	10	32	100.0

Source: Survey of auction operators.

would sell during the year. Taking into account the volume of business in the preceding 9 months and their expectations as to the balance of the year, the 42 operators estimated that during 1943 they would handle a total of 490,144 cattle and calves; 315,548 hogs and pigs; 6,312 sheep and lambs; and 15,892 mules, horses and colts; the total value of which they estimated to be $19,663,466. An observation of the above figures will show that cattle is the most important class of livestock handled, contributing about three-fifths of the total number sold. From the standpoint of their contribution to the total value of sales, cattle are even more important. Thirty-two auction operators estimated that 71.4 percent of the total value of sales came from cattle, 22.3 percent from swine, 0.3 percent from sheep, 5.9 percent from mules, and 0.1 percent from miscellaneous sales. See tables 8 and 9.

Table 8. Estimated number of livestock sold at auctions, 42 auctions, Mississippi, 1943[1]

Kind of livestock	10 small auctions	10 medium auctions	10 large auctions	Other auctions	All auctions[2]
Cattle and calves	44,930	112,310	241,914	90,990	490,144
Hogs and pigs	16,060	71,650	185,433	42,405	315,548
Sheep and lambs	255	1,530	2,317	2,210	6,312
Total	61,245	185,490	429,664	135,605	812,004
Horses, mules, and colts	1,676	4,135	6,220	4,121	15,892

Source: Survey of auction operators.

[1] All auctions that operated in Mississippi at any time during the year.

[2] Includes 2 auctions which began operation after January 1, 1943, 5 auctions which ceased operation after January 1, 1943, and 5 auctions for which complete schedules were not obtained.

Table 9. Estimated value of sales and percentage of sales from different sources, 42 auctions, Mississippi, 1943[1]

Group	Value of Sales		Percentage of sales from					
	Total	Average	Cattle	Hogs	Sheep	Mules	Other	Total
Small auctions	$ 1,160,600	$ 116,060	78.70	14.35	.20	6.45	.30	100.00
Medium auctions	3,770,000	377,000	71.00	21.65	.45	6.80	.10	100.00
Large auctions	10,910,666	1,091,066	70.50	23.50	.25	5.65	.10	100.00
Other auctions[2]	3,822,200	....	(3)	(3)	(3)	(3)	(3)	(3)
All auctions	$19,663,466	$ 547,336[4]	71.36[5]	22.29[5]	.30[5]	5.94[5]	.11[5]	100.00[5]

Source: Survey of auction operators.

[1] All auctions that operated in Mississippi at any time during the year.

[2] Includes 2 auctions which began operation during the year, 5 auctions which ceased operation during the year, and the 5 auctions for which complete schedules were not obtained.

[3] Not available.

[4] Average for the 35 auctions which operated all the year.

[5] Average for the 32 auctions for which complete schedules were obtained.

Operators of small auctions estimated that they would handle an average of 6,125 head of livestock in 1943, operators of medium auctions an average of 18,549 head, and operators of large auctions an average of 42,966 head. The average estimated value of sales was $116,060 at small auctions, $377,000 at medium auctions, and $1,091,066 at large auctions. The sale of cattle was relatively more important and swine less important at small than at medium or large auctions. Small operators estimated that 78.7 percent of their total value of sales came from cattle and 14.4 percent from hogs, as compared to 71.0 percent and 21.7 percent for medium, and 70.5 percent and 23.5 percent for large auctions, respectively.

In order to determine whether or not auctions are regarded more favorably now than previously in areas where they have been established for a number of years, the number of livestock handled by 16 auctions that have been in operation 5 years or longer was computed for each of the past 5 years. It was found that the number of livestock handled per auction was 19,248 in 1939; 19,970 in 1940; 23,170 in 1941; 24,458 in 1942, and 25,190 in 1943. In other words, the 16 auctions were handling approximately one-third more livestock in 1943 than in 1939. During the same period, the number of livestock on farms increased only about one-tenth. It is significant that the number handled increased each year over the preceding year, thus indicating that the auction as an outlet for livestock has grown in favor from year to year. See table 10.

The 16 auctions discussed in the preceding paragraph were made up of three small, seven medium, and six large auctions. The number of livestock handled at the small auctions increased 44.8 percent from 1939 to 1943, those handled at the medium auctions increased 18.4 percent, and those handled at the large auctions increased 36.1 percent. However, on the basis of the increase in number handled, the increase at the large auctions is much more important. The average number of livestock handled at the large auctions increased 11,579 head during this 5-year period, the average number han-

Table 10. Estimated number of livestock handled per auction and the percentage increase over 1939, auctions that have operated 5 years or longer Mississippi, 1939-1943.

	3 small auctions		7 med'm auct'ns		6 large auctions		16 auctions	
Year	Livestock handled per auction	Increase over 1939	Livestock handled per auction	Increase over 1939	Livestock handled per auction	Increase over 1939	Livestock handled per auction	Increase over 1939
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
1939	5,744	....	14,033	......	32,083	....	19,248	.....
1940	6,119	6.5	14,784	5.4	32,946	2.7	19,970	3.8
1941	7,001	21.9	15,689	11.8	39,984	24.6	23,170	20.4
1942	7,874	37.1	16,214	15.5	42,369	32.1	24,458	27.1
1943	8,258	44.8	16,613	18.4	43,662	36.1	25,190	30.9

Source: Survey of auction operators.

dled at the medium auctions increased 2,580 head, and the average number handled at the small auctions increased 2,512 head.

The area from which auctions draw their livestock varies considerably. Nine operators reported receiving all their livestock from a distance of less than 25 miles, 10 reported that they received some from a distance of from 25 to 50 miles, and 13 reported that they received some from a distance of over 50 miles. The operators estimated that they received 59.4 percent of their livestock from a distance of less than 25 miles, 27.5 percent from a distance of 25 to 50 miles, and 13.1 percent a distance of over 50 miles. See table 11.

As would be expected, small auctions draw their livestock from a smaller area than large auctions. Small operators estimated that they received 97 percent of their livestock from a distance of less than 25 miles, medium operators 69.5 percent, and large operators 49.3 percent. Large operators reported that they received 18.2 percent of their livestock from a distance of over 50 miles, medium operators 6 percent and small operators none. Nine large and four medium operators reported that they received animals from a distance of over 50 miles.

Table 11. Estimated percentage of livestock drawn from specified distances and number of auctions reporting receiving livestock each distance, 32 auctions, Mississippi, 1943.

Miles	10 small auctions		10 medium auctions		10 large auctions		32 auctions	
	Pct.	No.	Pct.	No.	Pct.	No.	Pct.	No.
Less than 25	97.0	10	69.5	10	49.3	10	59.4	32
25-49	3.0	3	24.5	9	32.5	10	27.5	23
50 & above			6.0	4	18.2	9	13.1	13
Total	100.0	10	100.0	10	100.0	10	100.0	32

Source: Survey of auction operators.

Livestock is received mainly from farmers and traders, though some are consigned by the auction companies. Auction operators estimated that farmers consigned 65.3 percent of the cattle and 73.4 percent of the swine, that traders consigned 28.4 percent of the cattle and 22.2 percent of the swine, and that the auction company consigned 6.3 percent of the cattle and 4.4 percent of the swine. Some consignments were received from other auction companies, but these were included with the number consigned by traders. In other words, according to these estimates, farmers consign about 7 out of every 10 animals sold. It should be pointed out that the estimated percentage shown for farmers may be too high because some auction operators seemed to want to emphasize the fact that their auction was a farmer market rather than a trader market. See table 12.

Traders consigned a larger proportion of the livestock at small auctions than was the case at medium and large auctions. Farmer consignments were more important at large auctions than at either of the other size groups. Large operators consigned a smaller proportion of livestock to their own sale than did small and medium operators.

Table 12. Estimated percentage of livestock consigned by different groups, 32 auctions, Mississippi, 1943.

Group	Cattle and Calves				Hogs and Pigs			
	10 small auctions	10 medium auctions	10 large auctions	32 auctions	10 small auctions	10 medium auctions	10 large auctions	32 auctions
Farmers	56.3	54.5	71.0	65.5	58.8	67.0	78.0	73.4
Traders	35.1	35.9	24.4	28.4	32.6	27.9	18.4	22.2
Auction company	8.6	9.6	4.6	6.3	8.6	5.1	3.6	4.4
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Survey of auction operators.

The rapid development of auctions, which has resulted in their becoming the most important outlet for livestock in Mississippi, has reacted differently on the other marketing outlets. The number of local shippers has in all probability decreased, since a considerable amount of livestock is bought at auctions by packer buyers or order buyers representing packing plants who ship the animals themselves. The need for the service of the terminal public market also seems to have decreased since packer buyers ship animals directly to packing plants in many instances. On the other hand, the number of local dealers or truck buyers has increased considerably. These dealers buy mostly in the country for sale through the auction and at the auction for sale in the country.

FACILITIES AND PLANT ORGANIZATION

Facilities provided by auction companies varied greatly; in many cases they were inadequate, while in other cases they appeared quite ample. Half the auctions for which complete schedules were obtained were located within the corporate limits of towns and cities, and most of the remainder were located just outside the corporate limits. In only a few cases were auctions located as far as 2 miles from town. Seven small, four medium, and three large auctions were located within the corporate limits.

The area covered by auction facilities varied from 0.5 acre in the case of one small auction to 8 acres for one large auction. Small auctions covered an average of 2.3 acres, medium auctions 4.0 acres, and large auctions 3.8 acres. In addition, five auctions had from 11 to 150 acres of adjoining pasture land.

Buildings, Pens, and Alleys

Barns constructed specifically to house auctions were used by 23 auctions. Of the nine auctions using remodeled buildings, six were classified as small, one as medium, and two as large. The remodeled buildings included two ordinary barns, a mule barn, a polo horse barn, a warehouse, a CCC building, an oilmill shed, a garage, and a gin shed. In general, barns constructed to house auctions provided much better facilities than remodeled barns, and the most recently constructed barns showed much improvement over the older ones both in the adequacy and arrangement of facilities.

All barns are rectangular or square in shape, the majority being rectangular. Barns varied in size from 30 by 80 feet to 200 by 300 feet. All barns averaged 14,831 square feet of floor space with small auctions averaging 5,916 square feet, medium auctions 12,748 square feet, and large auctions 28,377 square feet. Some auctions have the barn, office, rest rooms, lunch room, and sales ring under the same roof. The sales ring was located in the barn in all cases but in some cases the office, lunch room, and rest rooms were in separate buildings. In some cases lunch rooms and rest rooms were not provided; in one instance no office was provided, all book work being done on the auctioneer's stand.

One or more loading or unloading chutes were provided at all auctions with the same chutes serving both purposes in some cases. Alleys lead from the chutes to the pens where the cattle are held until they are ready to sell, and the same or other alleys connect these pens with the sales ring. The scales are located to one side of the auction ring and in many cases they open into the ring. In a few instances the scales are arranged in such a way that the weigher is stationed in the office. Other alleys connect the scales with the buyers' pens, and the buyers' pens with the loading chutes.

The number of pens per auction varied from 8 to 150 and averaged 58 for all auctions. Small auctions had an average of 27 pens, medium auctions an average of 60, and large auctions an average of 86. Of these pens, about one-third of those at small auctions were covered, about one-half of those at medium auctions, and about two-thirds of those at large auctions. A few of the small auctions had no covered pens. One large and one medium auction had all pens covered except one or two large holding pens. The area covered by outside pens averaged 0.4 acre for small auctions, 1.1 acres for medium auctions, 1.2 acres for large auctions, and 0.9 acre for all auctions.

While covered pens allow buyers to observe livestock more closely in bad weather and cut down on shrinkage in both hot and cold weather, they are more likely to harbor diseases than open pens unless they are floored with a hard-surface material that can be cleaned and disinfected easily. Open pens have the advantage of sun and air and dry out more quickly than covered pens, which may stay damp for quite some time after becoming wet. Covered pens were observed at some auctions the floors of which were half covered in mud and water. It should be remembered that covered pens are less likely to become wet unless located on low, poorly-drained land. All pens, covered or uncovered, should have a high, well-drained location.

Eighty-four percent, or all except five auctions, had dirt floors in all pens. One medium auction had plank floors in some pens, and four large auctions had cement floors in hog pens and dirt floors in cattle and other pens. Pens with dirt floors were in fairly good condition at some auctions but they left much to be desired at others.

Fifteen operators reported the cleaning of pens after each sale, one every 2 weeks, three every month, two every 3 months, three every 6 months, seven once a year, and one reported cleaning hog pens after each sale and other pens every 6 months. It should be observed that while almost half the operators cleaned their pens after each sale, almost one-fourth of them cleaned their pens only once a year. As a group, large auctions kept their premises cleaner than medium or small auctions. Six operators of large auctions five operators of medium auctions, and three operators of small auctions reported cleaning their pens after each sale. See table 13.

Seven operators reported the disinfecting of pens after each sale, 1 every 2 weeks, 2 every month, 1 every 2 months, 3 every 6 months, 5 every year, 1 every week during wet weather, 1 irregularly, and 11 never. It must be pointed out that while one operator out of three reported that he never disinfected his pens, only one out of five reported disinfecting after each sale. Some operators that reported disinfecting do so at such infrequent intervals that effective disease control is impossible. Again

Table 13. Frequency of cleaning pens, 32 auctions, Mississippi, 1943

Frequency	10 small auctions	10 medium auctions	10 large auctions	32 auctions	
	number	number	number	number	percent
After each sale	3	5	6	15	46.9
2 weeks			1	1	3.1
1 month	1	2		3	9.4
3 months	1		1	2	6.3
6 months	2			3	9.4
1 year	3	3	1	7	21.9
Other			1[1]	1	3.1
Total	10	10	10	32	100.1

Source: Survey of auction operators.

[1] Hog barn after each sale, cattle barn every 6 months.

it must be pointed out that sanitary conditions are more likely to be found at large than at medium or small auctions. Four operators of large auctions reported that their pens were disinfected after each sale, whereas, only two operators of medium auctions and one of the operators of small auctions reported such a procedure. See table 14.

The yard capacity at different auctions varied greatly, from less than 250 head at two small auctions to more than 2,000 head at five large auctions and averaged 1,098 head for all auctions. Small auctions had an average yard capacity of 535 head, medium auctions an average of 880 head, and large auctions an average of 1,985 head. See table 15.

The average number of livestock handled per sales day varied from less than 100 at three small auctions to over 1,500 at one large auction and averaged 468 for all auctions. Small auctions handled an average of 129 head per sales day, medium auctions an average of 375, and large auctions an average of 905. See table 16.

Table 14. Frequency of disinfecting pens, 32 auctions, Mississippi, 1943

Frequency	10 small auctions	10 medium auctions	10 large auctions	32 auctions	
	number	number	number	number	percent
Never	3	4	3	11	34.4
After each sale	1	2	4	7	21.9
2 weeks			1	1	3.1
1 month		2		2	6.3
2 months				1	3.1
6 months	2		1	3	9.4
1 year	3	2		5	15.6
Other	1[1]		1[2]	2	6.3
Total	10	10	10	32	100.1

Source: Survey of auction operators.

[1] Every week during wet weather.

[2] Irregularly.

Table 15. Yard capacity, 32 auctions, Mississippi, 1943

Capacity	10 small auctions	10 medium auctions	10 large auctions	32 auctions	
	number	number	number	number	percent
Less than 250	2			2	6.3
250-499	4			5	15.6
500-999	1	6		8	25.0
1000-1499	3	4	2	9	28.1
1500-1999			3	3	9.4
2000 and above			5	5	15.6
Total	10	10	10	32	100.0
Av. capacity	535	880	1985	1098	

Source: Survey of auction operators.

Table 16. Average number of livestock handled per sale day, 32 auctions, Mississippi, 1943

Number of livestock	10 small auctions	10 medium auctions	10 large auctions	32 auctions	
	number	number	number	number	percent
Less than 250	10[1]	2		13	40.6
250-499		6		6	18.8
500 999		2	6	9	28.1
1000-1499			3	3	9.4
1500-1999			1	1	3.1
Total	10	10	10	32	100.0
Av. per auction	129	375	905	468	

Source: Survey of auction operators.

[1] Three of these handled less than 100.

When these figures are compared with the average yard capacity of the different size groups, it will be observed that small auctions handled an average of 24 percent of their capacity, medium auctions 43 percent of their capacity, and large auctions 46 percent of their capacity. This does not necessarily mean that auctions have been overbuilt, since most of them are used to capacity during certain seasons of the year. At other times, the volume may dwindle to practically nothing. For example, a small sale was attended at which only 19 head of livestock was sold that day as compared to the average of 125 head per sale for the year.

Sales Pavilions and Rings

The type, size, and completeness of pavilions provided by the various auction companies varied greatly. All pavilions were located in the auction barn, although in a few instances the pavilion and a few sorting or holding pens comprised all the barn. In a few cases, the pavilion was boarded up to keep out the noise, which at times is so loud as to make it practically impossible to hear the auctioneer; this is especially true at large auctions where a large number of calves is handled.

An elevated platform boarded on the front by a rough counter or table was used by the auctioneer and one or more clerks at all auctions. This point of vantage enables the auctioneer to observe livestock and bidders more closely and the clerk to check the tag numbers of animals as they go through the ring and to check with the auctioneer as to the price if he is in doubt.

Some auctions were equipped with stoves for use during cold weather and fans for use during hot weather. Practically all auctions used artificial light in the ring, and quite a few of the larger ones were equipped with amplifiers to enable the auctioneer to make himself understood more clearly.

Most pavilions are rectangular in shape and are usually bordered on three sides by elevated seats; however, in some cases, seats are provided on only one or two sides of the ring. In some cases, permanent seats had been provided but in most cases they were planks laid on supports. The seating capacity varied from less than 100 for four small auctions to more than 400 for one each of the medium and large auctions, and averaged 181 for all auctions. Small auctions had an average seating capacity of 118, medium auctions an average of 174, and large auctions an average of 255. See table 17.

The average attendance varied from less than 100 at three small auctions to more than 500 at two large auctions, and averaged 228 for all auctions. The attendance at small auctions averaged 114, at medium auctions 190, and at large auctions 355. See table 18 on page 29. It will be observed that on an average only small auctions provided sufficient seats, the average attendance at medium and large auctions exceeding their seating capacity by 16 and 100 persons, respectively. This crowded condition is accentuated at times, since attendance is much higher during certain seasons of the year than at others.

The majority of sale rings were rectangular or square and varied in size from 15 by 15 feet to 25 by 50 feet. All sale rings averaged 604 square feet in size. Some of the better constructed rings were enclosed with a fence of steel pipes or strong lumber. In at least one instance the sales ring was completely cut off from the seats by a high fence of wire netting but in quite a few instances the seats formed the boundary of the ring. Some rings that were fenced in had a row of seats on the inside of the ring for the buyers, and in at least two instances bales of hay served the same purpose.

Table 17. Seating capacity, 30 auctions, Mississippi, 1943[1]

Seating capacity	9 small auctions	10 medium auctions	10 large auctions	30 auctions	
	number	number	number	number	percent
Less than 100	4	2		7	23.3
100-199	3	4	1	8	26.7
200-299	1	2	5	8	26.7
300-399	1	1	3	5	16.7
400-499		1	1	2	6.7
Total	9	10	10	30	100.1
Av. capacity	118	174	255	181	

Source: Survey of auction operators.

[1] One small auction and one of the auctions which began operation after January 1, 1943, were omitted because the sale was held in the show pavilion of the local fair which would seat about 1,000 persons in each case.

One or more sorting or holding pens were provided by all auctions. These pens were located just outside the ring and greatly facilitated the flow of animals into the ring. At some auctions a bunch of hogs would be run into the ring together and the hog or hogs to be sold separately cut off from the bunch by means of hurdles.

Two gates to the ring were provided at all auctions, but they were so close together in a few instances that the flow of livestock was held up. The better arranged auctions had the gates at opposite ends of the ring or else far enough apart to permit another animal to enter as soon as the last bid was made on the preceding one, without interfering with its removal from the ring.

Scales

All auctions except one of the smaller ones were equipped with scales. Two operators reported that they

Table 18. Average attendance, 30 auctions, Mississippi, 1943[1]

Average attendance	9 small auctions	auctions 10 medium	10 large auctions	30 auctions	
	number	number	number	number	percent
Less than 100	3	1		5	16.7
100-199	5	5	2	12	40.0
200-299	1	2	2	5	16.7
300-399			3	3	10.0
400-499		2	1	3	10.0
500 and above			2	2	6.7
Total	9	10	10	30	100.1
Av. attendance	114	190	355	228	

Source: Survey of auction operators.

[1] The two auctions described in the footnote to table 17 were omitted in order to make the table comparable.

sold all cattle by the head unless the consignor requested otherwise. Practically all hogs are sold by weight. Forty-five percent of the auctions were equipped with registering beam scales, the remainder being equipped with ordinary beam scales. Two small, five medium, and six large auctions were equipped with registering type scales. This type scale allows the weigher to stamp the weight on a ticket which comes in duplicate or triplicate. The weigher must record the weight by hand at those auctions where ordinary beam scales are used.

The age of scales varied from 1 to 25 years, and average 6.4 years for all auctions. The average age of scales was 8.2 years at small auctions, 6.6 years at medium auctions, and 4.3 years at large auctions. Six small, three medium and seven large auctions have scales 5 years of age or less. See table 19.

Scales at all auctions were under cover, and in a few instances were enclosed in cases. Three auctions out of every five reported that they tested their scales them-

Table 19. Age of scales, 31 auctions, Mississippi, 1943[1]

Years	9 small auctions	10 medium auctions	10 large auctions	31 auctions	
	number	number	number	number	percent
5 and under	6	3	7	17	54.8
6 - 10	1	5	2	9	29.0
11 - 20	1	2		3	9.7
21 and above	1			1	3.2
Unknown			1	1	3.2
Total	9	10	10	31	99.9
Average age of scales	8.2[2]	6.6	4.3[2]	6.4[3]	

Source: Survey of auction operators.

[1] One small auction had no scales.

[2] Average for 9 auctions.

[3] Average for 30 auctions.

selves using various methods such as weighing 100 pound sacks of feed, men who have weighed elsewhere, and standard test weights; however, only two of these auctions reported using standard test weights and one of these used 50-pound weights. Eight auctions reported testing by competent testers twice a year and two auctions once a year. Of the eight reporting testing twice a year by competent testers, four came under the Packers and Stockyards Act. See table 20.

One small, three medium, and four large auctions reported the testing of scales once or twice a year by competent testers. Eight small, three medium, and six large auctions reported testing their own scales. Two operators of medium auctions who rented their facilities and who lived out of town and only visited the sales barn on sales day, reported that they did not know whether or not the scales were ever tested.

Table 20. Frequency of testing scales and agency doing testing, 31 auctions, Mississippi, 1943

Frequency	Agency doing testing	9 small auctions	10 medium auctions	10 large auctions	31 auctions	
		No.	No.	No.	No.	Pct.
Week	Auction Co.	5	3	4	13	41.9
2 weeks to 2 months	Auction Co.	2		1	3	9.7
2 months to 6 months	Auction Co.	1		1	2	6.5
6 months	Auction Co.		1		1	3.2
6 months	Competent tester		2[1]	4[2]	7[3]	22.6
Year	Competent tester		1		1	3.2
Unknown	....		2		2	6.5
Other	.... ..	1[4]	1[5]		2	6.5
Total	....	9	10	10	31	100.1

Source: Survey of auction operators.

[1] One by scales company and 1 by scales company under federal supervision.

[2] One by scales company and 3 by scales company under federal supervision.

[3] One by state agency.

[4] Every week by auction company, once a year by a state agency.

[5] Every week by auction company, every 6 months by scales company.

The location of the scales is an important factor in keeping an uninterrupted flow of animals going through the ring. Some scales opened directly into the ring, some were located just outside the ring, and others were separated from the ring by a holding pen. When the scales do not open directly into the ring, the flow of animals is slowed down since an extra gate is required. This extra gate also necessitates the use of an additional helper. In some cases where the scales opened into the ring the flow of animals was slowed down due to the fact that the scales gate was located too close to the gate through which the animals entered the ring. In at least one instance the scales had only one gate, which slowed up the sale considerably. To insure an uninterrupted flow of animals, the scales should open into the ring and have another gate at the opposite end so that another animal can enter the scales before the preceding one is completely out.

Value of Facilities

A considerable sum of money is invested in auctions in Mississippi. Thirty-two auction operators estimated the total value of their facilities to be $273,292 or an average of $8,540 per auction. When this average is applied to the five auctions for which complete schedules were not obtained, it is seen that the value of all auction property in the State exceeds $300,000. This investment is quite heavy when one considers the fact that most auctions hold sales only once per week. In fact, the investment is so heavy under these conditions that several operators use their auction barns the balance of the week for trading in workstock or livestock in order to utilize the facilities more completely and spread the capital cost as much as possible.

The value of facilities varied from $1,000 at one small and one medium auction to $50,000 at one large auction. The total value of facilities averaged $3,100 for small auctions, $5,559 for medium auctions, and $18,200 for large auctions. See table 21.

Seventeen or slightly more than one-half the auctions were owned entirely by their operators. Facilities at 12 auctions were leased, and those at 3 others leased in part. The facilities at auctions owned entirely exceeded in value by a considerable amount those at auctions leased in whole or in part. The value of facilities owned entirely averaged $12,029 per auction; those partially owned, $4,333; and those leased, $5,200.

Some operators who leased their facilities paid a stated monthly or annual rent, others paid the owners all yardage charges collected. The annual rent averaged $1,033 for auctions leasing all facilities, and $243 for auctions leasing part of their facilities.

Table 21. Total value of facilities, 32 auctions, Mississippi, 1943

Value of facilities	10 small auctions	10 medium auctions	10 large auctions	32 auctions	
	number	number	number	number	percent
Under $2500	4	3		8	25.0
$2500-$4999	4	3		8	25.0
$5000-$9999	2	2	1	5	15.6
$10000-$14999			4	4	12.5
$15000-$19999		2		2	6.3
$20000 and above			5	5	15.6
Total	10	10	10	32	100.0
Average value of facilities	$3,100	$5,559	$18,200	$8,540	

Source: Survey of auction operators.

Personnel

The number and efficiency of personnel contributes greatly toward the success or failure of a particular auction. Employees at some auctions were energetic and seemed anxious to do a good job, while those at others were slow and indifferent. A continuous flow of animals was usually kept going through the ring at the former, while the flow of animals at the latter was likely to be slow and spasmodic. The number of employees also has much to do with the speed with which animals pass through the ring, since a small number of men, no matter how efficient, cannot keep things moving smoothly if the same man has to perform two or three jobs.

The number of employees per auction varied from 8 at 1 small auction to 39 at 1 large auction, and averaged 18 for all auctions. The auctions had an average of 1 auctioneer, 2 ringmen, 10 yardmen, 1 weigher, and 4 clerks per auction. The number of auctioneers per auction ranged from 1 to 2, ringmen from 1 to 4, yardmen from 2 to 30, weighers from none to 1, and clerks from 2 to 8. Small auctions had an average of 12 employees; medium auctions, 17; and large auctions, 25. See table 22.

Table 22. Number of employees per auction and the range in the number of employees, 32 auctions, Mississippi, 1943

Class of employee	10 small auctions		10 medium auctions		10 large auctions		32 auctions	
	no.	range	no.	range	no.	range	no.	range
Auctioneers	1	1	1	1-2	1	1-2	1	1-2
Ringmen	2	1-3	2	1-4	3	1-4	2	1-4
Yardmen	5	2-8	9	5-15	15	6-30	10	2-30
Weighers	1	0-1	1	1	1	1	1	0-1
Clerks	3	2-4	4	3-6	5	3-8	4	2-8
Total	12	8-15	17	11-25	25	14-39	18	8-39

Source: Survey of auction operators.

OPERATING METHODS

While there is some variation in the way different auction owners operate their business, in general they follow a similar procedure. That is, in most cases they vary only in the details of operation.

Mechanics of Handling Livestock

Most livestock consigned to auctions for sale is brought in on sales day; however, some operators accept consignments on other days. Thirteen operators reported that they received livestock on days other than the day of the sale; 7 reported that they did not make a practice of receiving livestock on other days; and 12 reported that they received livestock only on the day of the sale. A greater percentage of large and medium operators reported receiving livestock on days other than the sales days than did small operators.

A considerable amount of livestock is brought in after the sales start. All operators reported that they accepted consignments after the sale started; however, the majority stated that animals brought in after the selling of that particular class of livestock had been finished, were held until the end of the sale before selling. At some auctions, consignors were observed bringing in animals until shortly before the end of the sale. Some producers make a practice of going to the auction and observing prices paid for the kind of animals they have for sale before bringing their animals to the auction. If they consider prices unfavorable, they wait until a later date to deliver their animals; if favorable they deliver them that day. Other producers deliver their animals as late in the sale as possible in order to reduce the shrinkage as much as possible and in this way increase their receipts, but they defeat their own purpose in some instances, since they may receive a lower price due to some buyers having already bought all they want of that particular grade of animal. Also, experienced buyers allow for the fill in animals when they place their bids so that even if all buyers still want that kind of livestock, the total value would be no more and in many cases less, as buyers, to protect themselves, will tend to overestimate rather than underestimate the fill.

Cattle were tagged at all auctions before being penned. Some auctions tagged all swine, some only those of small consignors, and some tagged no swine. The number of pens available for swine was usually the factor determining whether or not they were tagged. In those cases where the swine were not tagged, each consignment was placed in a separate pen and a card giving the owner's name placed on the gate. All auctions observed used the same method of tagging; a cardboard tag clipped in the ear of the animal.

The operator usually has a chute or a delivery book in which he or one of his employees records, as each consignment is received, the name of the owner, the number and kind of livestock, the tag number of each animal tagged, and the number of the pen in which untagged animals are placed. Most operators give the consignors a duplicate of the delivery sheet or ticket, only seven reporting that they did not and five of these were small operators. One of the five small operators reported that the consignor was given a duplicate if he requested it.

Cattle were sorted and sold by groups at about three-fourths of the auctions. No grading was done; the animals were merely divided into groups, usually, cows, calves, heifers, steers, and bulls. This sorting was done as the animals were unloaded at the chutes and the animals driven to specified pens. Cattle were not sorted at the balance of the auctions, each consignment usually being sold in the order in which it was received. No sorting of swine was reported, each consignor's animals being sold in the order received at all auctions. Of course, if a consignor had several hogs of about the same weight and finish they might be sold together and usually were. Cattle were sold in groups occasionally but to a lesser extent than hogs.

Auction operators reported that 84.5 percent of the cattle, 31.3 percent of the hogs, and 63.0 percent of cattle and hogs together were sold one at a time. All size-groups reported about the same percentage of cattle sold one at a time, but small auctions reported a much larger percentage of hogs sold one at a time than did either of the other groups. See table 23.

Much time could be saved for all concerned if animals were graded and sold in pooled lots instead of on a strictly ownership basis. In general, it is likely that consignors would receive more for livestock sold in this manner. Buyers will pay more for a given grade of livestock if they are assured of a sufficient volume than if they have to buy animals one at a time and risk not

Table 23. Percentage of cattle and hogs that are sold individually, 32 auctions, Mississippi, 1943

Kind of livestock	10 small auctions	10 medium auctions	10 large auctions	32 auctions
Cattle and calves	81.5	83.0	85.5	84.5
Hogs and pigs	50.0	29.0	29.5	31.3
Cattle and hogs	73.2	62.0	61.2	63.0

Source: Survey of auction operators.

having a truck load or enough to ship; a larger number of buyers would probably be attracted if they knew they could come to the auction and buy what they wanted in a few minutes and not have to sit around a number of hours in order to purchase the desired animals. This would also tend to increase prices, since an increase in the number of buyers naturally increases the competition for animals. Seeking to determine what chance this method of selling has of being introduced in the near future by the auction companies themselves, the operators were asked to give their opinion of this method of sale and what they thought producers and buyers thought of it.

Twenty-seven operators reported that they thought this method of sale would not suit the producers and five reported that they did not know. None of the operators thought producers would prefer this method of sale. Eleven operators reported that they thought buyers would prefer this method of sale, 3 that some buyers would, 1 that it would not matter to the buyers, 1 that it was doubtful if any of the buyers would, 12 that buyers would not, and 4 that they did not know. Twenty-five operators reported that they thought they would not like this method of sale, three that they would, and four that they did not know.

The most important reasons given by operators for not wanting to grade and sell livestock in pooled lots are: the consignor would not be as well satisfied as under the old system because each consignor with animals in a pool would think his animals better than the others in the same pool; this method of sale would take too much time; and the volume handled is too small for the effective use of this method of sale.

It is evident from the attitude of the operators that this method of sale has very little chance of being introduced in the near future by the auction companies themselves. Even when this method of sale is adopted, certain classes of animals such as dairy cows, breeding stock, and mules will, in most cases, continue to be sold one at a time.

The order in which livestock are sold varies to some extent among different auctions; however, the most common order of sale was (1) horses, (2) hogs, and (3) cattle. Sheep and goats were usually sold just after hogs. This pattern of sale did not vary greatly between the different size groups of auctions. See table 24.

All operators except three reported that they followed the same order of sale at all times. Of the three operators who varied the order of sale, two reported that they sold the livestock for which the most buyers were present and one reported that when bidding was dull for a particular kind of livestock, he shifted to another kind and returned to the former later in the sale. It appears that operators should follow the example set by the majority of operators and follow the same order of sale at all times since the advantages gained on a particular day are more than offset by confusion among buyers as to when a particular kind of livestock will be sold on succeeding sale days. Buyers who want to buy only one kind of livestock do not like to come to the

Table 24. Order of sale, 32 auctions, Mississippi, 1943

Order of sale		10 small auctions	10 medium auctions	10 large auctions	32 auctions	
		number	number	number	number	percent
	first	8	4	5	17	58.6
Horses	second		3	1	4	13.8
	third	2	2	2	8	27.6
	first	1	5	2	8	25.0
Hogs	second	7	4	7	20	62.5
	third	2	1	1	4	12.5
	first	1	1	3	7	21.9
Cattle	second	3	3	2	8	25.0
	third	6	6	5	17	53.1

Source: Survey of auction operators.

sale and sit around for hours before the animals in which they are interested are sold. This practice, if followed extensively, will probably lead to a decrease in consignments since some buyers will, in all likelihood, discontinue patronage of the sale; and thus, the demand for and prices of livestock will be affected.

There is one other important reason why the order of sale should not be shifted. It has been reported in other states that "at some auctions the order of sale has been switched for the convenience of traders so they can purchase certain classes of stock without too much competition from farmers." In other cases, "the order is varied so that the management can run its own or traders' stock in when the bidding is active."[1] Since farmers do not always know the motive behind the shift in the order of sale, operators would do well to remove all doubt by following the same order of sale at all times.

The actual selling of livestock is carried on much better and faster at some auctions than at others. At some of the smaller auctions when a consignor rejects the bid, the auctioneer, or ringman in some cases, asks the consignor what he will take. The consignor sets a figure and if this is not suitable, the auctioneer or ringman makes an offer and the sale breaks down into private barter. This practice slows down the sale and should be avoided for other reasons. It will not take consignors long to realize that they are not getting top prices for their animals if the auctioneer is willing to raise the price in some cases where the bid is rejected. Under these conditions, consignors lose confidence in the auction and consignments fall off.

The rings at some auctions were so crowded with buyers and on-lookers that it was practically impossible for a person sitting in the seats provided to see the animal going through the ring. This crowded condition slows down the flow of animals through the ring, since some of the people get in the way of the animals. The examination of animals, especially dairy cows, in the ring by the buyers takes up a great deal of time at most auctions. Several minutes may elapse after a dairy cow is run in the ring before the bidding starts while buyers "bump" the cow to determine if she is with calf, examine her teeth to determine her age, and examine her udder and teats, and milk her to determine the condition of her udder. Much selling time could be saved if these cows were examined when unloaded, the desired information placed on a card and handed to the auctioneer to read as the animal enters the ring. Auction companies should be willing to guarantee all statements made concerning animals and to refund money in case something is overlooked. This would eliminate one of the arguments given for allowing buyers in the ring. Some operators state that buyers insist on handling animals before buying, but it was observed that big buyers seldom, if ever, entered the ring for the purpose of examining the animals. Two of the largest auctions in the State allow no one in the ring but the ringmen. Thus, it is evident that the handling of animals by buyers is not essential to the success of an auction.

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[1] Randell and Mann, **Livestock Auction Sales in the United States,** Farm Credit Administration, Cooperative Research and Service Division, Bulletin 35, p. 50.

Twenty-two operators reported that they allowed anyone in the ring, three that they allowed anyone in the ring but discouraged it, four that they allowed only buyers and ringmen in the ring, and three that they allowed no one in the ring except the ringmen. Conditions in this respect were better at large than medium or small auctions since only four large auctions allow anyone to enter the ring without restrictions.

Five operators reported that they reserved the first row of seats for buyers, 1 that he tried to, but could not, and 26, that no seats were reserved for buyers. If the first row of seats were reserved for buyers, it is believed that very few would complain about not being allowed in the ring, because they would have an unobstructed and close view of each animal as it passed through the ring.

The selling time per animal handled varied from less than 30 seconds at one medium and four large auctions to more than 2 minutes at two small auctions and averaged 40 seconds for all auctions. Selling time per animal handled averaged 86 seconds for small auctions, 44 seconds for medium auctions, and 29 seconds for large auctions. See table 25.

Table 25. Selling time per animal handled, 32 auctions, Mississippi, 1943[1]

Selling time (seconds)	10 small auctions	10 medium auctions	10 large auctions	32 auctions	
	number	number	number	number	percent
Less than 30		1	4	6	18.8
30 - 59		7	6	13	40.6
60 - 89	6	1		7	21.9
90 - 119	2	1		4	12.5
120 - 150	2			2	6.3
Total	10	10	10	32	100.1
Av. selling time	86	44	29	40	

Source: Survey of auction operators.

[1] Calculated using the average number of livestock and workstock handled per sale day and the average hours that selling began and ended.

It is evident from the figures presented above that size of business is an important factor affecting selling time per animal handled. Small auctions required more selling time per animal handled than did medium auctions and medium auctions more than large auctions. In order to try to determine if other factors affected selling time per animal handled, each size group was divided into two groups—the five fastest selling auctions and the five slowest selling auctions. When this was done, it was found that in each group the fastest selling auctions sold more livestock per sale day, employed more workers, and had more pens. Thus, it seems that in addition to size of business, the number of employees and facilities in terms of the number of pens also have some effect on selling time per animal handled. The total value of facilities did not have any consistent effect on the selling time per animal, the average value of facilities at the five fastest selling medium auctions being less than half as much as those at the slowest selling auctions in the same group.

An observation of table 26 will show that the five fastest selling medium auctions required only slightly more selling time per animal handled than the five fastest selling large auctions. Thus, it appears that a volume of 400 to 500 head of livestock is required before the operators feel that they can profitably employ a sufficient number of men to handle the livestock efficiently. The five fastest selling medium auctions employed an average of 21 workers (13 yardmen, 4 clerks, 2 ringmen, 1 auctioneer, and 1 weigher); this seems to be about the minimum number required to keep a continuous flow of animals going through the ring.

It should be remembered that the number of animals sold one at a time is one of the most important factors determining selling time per animal handled and that small auctions sold a larger percentage of their animals in this manner than did medium or large auctions. Other factors affecting selling time per animal handled are: the arrangement of facilities; the presence or absence of buyers and on-lookers in the ring; an auctioneer who is a good judge of livestock and does not waste time seeking additional bids after the top price for a particular animal has been bid; a ringman who knows the value of livestock and can start the bidding close to the market price of the animal; and the presence or absence of barter in the ring between the auctioneer, ringman, or buyers, and the consignors who have rejected bids.

Table 26. Selling time per animal handled and factors affecting selling time, 32 auctions, Mississippi, 1943

Item	10 small auctions		10 medium auctions		10 large auctions	
	5 fastest selling auctions	5 slowest selling auctions	5 fastest selling auctions	5 slowest selling auctions	5 slowest selling auctions	5 fastest selling auctions
Selling time per animal seconds[1]	69	110	34	59	25	34
Average number of animals sold per sale day	162	114	434	332	1158	717
Average number of employees	13	10	21	13	26	24
Average number of pens	34	20	61	59	92	79
Average value of facilities, dollars	4000	2200	3000	8118	4200	12200

Source: Survey of auction operators.

[1] See footnote to table 25.

Most livestock is transported to and from auctions in trucks, more being transported to auctions in this manner than away from them. Trucks transported 97.4 percent of the livestock to auctions and 74.2 percent of it away. Trains transported 1.8 percent of the livestock to auctions and 25.5 percent of it away. Only 0.8 percent of the livestock was moved to auctions and 0.3 percent away from auctions in wagons or on foot. Trains were more important in the transportation of livestock to and from large auctions than at small or medium auctions.

Soliciting Business

Auction operators employ various methods to obtain livestock and keep up their volume of business. Most operators use some form of publicity to influence farmers and dealers to consign livestock to the auction. Only five reported that they used no form of publicity. Two others reported that they did not advertise regularly. Eighty percent of the 25 auctions advertising regularly used newspapers, 72 percent used letters or price cards, and 28 percent used the radio. Most auctions used more than one form of advertising. Twenty-four percent of the auctions used all forms of publicity mentioned above, 56 percent used two, and 24 percent used only one form of publicity.

Small auctions advertise less than medium size auctions and medium size auctions advertised less than large auctions. All large auctions reported that they advertised regularly, while only six small and seven medium auctions followed such a procedure. Records kept by auction companies also show that larger auctions do more advertising than smaller auctions. Three small auctions spent an average of $8.33 for advertising in 1943, two medium auctions an average of $133.75, and two large auctions an average of $291.54. See table 28 on page 53 for a detailed account of the expenses of these auctions.

Many operators make a regular practice of buying in the country and at other auctions to supplement their consignments and thus have as large a volume as possible in order to attract buyers. Others buy in the country and at other auctions for sale through their own auction only when consignments fall off.

Some operators attempt to keep up or increase their consignments by hauling livestock free or for out-of-pocket cost. Several operators make a practice of furnishing credit to dealers with the understanding that they will buy in the country and elsewhere for sale through their auction. Still other operators attempt to increase their consignment by reducing commission charges to large consignors.

The operators should realize that some of their attempts to increase consignments by methods other than advertising may be partially or completely offset by other factors. For example, ill-feeling among small consignors due to the cutting of commission charges to large consignors may cause total consignments to fall off rather than increase.

Frequency of Sales

Most auctions hold sales at weekly intervals. Thirty auctions held weekly sales, four held bi-weekly sales, one held monthly sales, one held weekly sales part of the year and bi-weekly sales part of the year, and one held weekly sales part of the year. Eight small, nine medium, and eight large auctions held weekly sales in 1943.

Small operators could operate more efficiently if they held sales bi-weekly or monthly instead of weekly. By doing this, they would reduce operating expenses and at the same time, attract a larger number of buyers due to the larger volume per sale day. It is known that most large buyers shun small auctions because the small volume of livestock makes it practically impossible to purchase a load of any one grade of livestock. A larger number of buyers would, in all probability, mean an increase in competition, higher prices, and an increase in total consignment. On the other hand, it would pay some of the larger auctions to hold two sales per week if they continue to follow their present system of selling each consignment individually. Some sales last so late at night that many farmer buyers and some big buyers go home before the sale is completed, thus leaving the field to a small number of buyers with the result that prices deteriorate in some instances. However, if large operators would adopt the plan of grading and selling in pooled lots. which was discussed under the mechanics of operation, the weekly sale would give the best results.

Sales are held throughout the week. Seven sales were held on each of the first 5 days of the week and two were held on Saturday. Saturday was an unpopular sales day because many of the auctions run until late at night and do not get through checking out animals until the next morning. Sales dates were evenly scattered throughout the first days of the week because operators realize that competition among buyers is essential to the successful operation of a sale. For this reason, operators try to arrange sale dates so as to facilitate the movement of buyers from one sale to another.

The opening hour for sales ranged from 10:30 o'clock in the morning to 3 o'clock in the afternoon, with 1 o'clock being the most popular starting hour. Small auctions can start selling at 1 p. m. or later and get through before dark, whereas some large and medium auctions are forced to sell until late at night. It would seem to be wise for these operators to move the opening hour of selling up as much as possible in order to allow farmer buyers, many of whom have to leave late in the evening to do their chores, to stay and take part in the bidding as long as possible.

Selling Methods

Auctioneers hired by the management do the selling at 21 auctions, owners or part-owners at 6 auctions, and the owner or part-owner and a hired auctioneer at 5 auctions. In general, auctioneers were fairly well trained and posted as to the value of livestock; however, in some cases, they showed a lack of knowledge of the value of livestock and of training in the art of auctioneering. Most auctioneers work at more than one sale and some of them have a regular circuit that they make each week. Auctioneers who work several sales a week can afford to charge a smaller fee per sale than the auctioneer working only one or two days. This is important since it offers a way of cutting down operating expenses by reducing the auctioneer's fee which is one of the large items of cost in operating an auction.

The ringmaster starts the bidding at the majority of auctions, and in most cases the ringmaster is also the owner or part-owner of the auction. The owner or part-owner of the auction acting as ringmaster starts the bidding at 21 auctions, the owner or part-owner acting as auctioneer at 1 auction, hired ringmasters at 3 auctions, hired auctioneer at 1 auction, and anyone who desires to do so at the remaining 6 auctions. The bidding is started by the operator of the auction in order to save time. When the first bid is left to the buyers, several seconds may elapse after the animal enters the ring before a bid is made, and even when made it may be so much below market price that quite some time is required to get the bid up to market price.

In addition to the ringmaster, there were one or more assistant ringmen at most auctions. These men move about the ring and encourage bidders by calling out strong points of animals. They also assist the auctioneer in locating and identifying buyers and the clerk in getting the tag number of animals and in delivering sales slips.

In addition, they examine those animals for which examinations as to age, condition and defects are desired.

By-bidding is the practice of bidding on one's own livestock. In some cases the owner does not bid on his stock himself, but has a friend to do so. This practice is employed by consignors and auction operators in some instances to run up the prices of their stock. All operators who were questioned as to their attitude toward this practice stated that they did not allow it if it could be prevented. Some operators stated that when they caught a man bidding on his own stock, they stopped the bidding and made him carry his animals home.

Buyers could reject purchases only when they could prove that they had been misrepresented in the ring, and in practically no cases could animals be returned after having been carried away from the barn. When animals are sold without any statement being made concerning their condition, it is understood that they are being sold "as is" and cannot be rejected by the buyer under any circumstances. At most auctions, buyers of mules were allowed to try them out at the auction and reject them at that time if they proved unsatisfactory.

Animals are frequently misrepresented at auction sales. It has been reported that some traders follow the practice of running a baby calf with a "bagged up" cow that is almost dry just long enough to make it appear that the calf belongs to the cow. Misrepresentation of the age of animals is a common practice at most auctions. It is so common, in fact, that practically all traders insist on seeing the mouth of animals that are not being sold for slaughter. Falsely stating that animals are safely bred, or giving so much milk in the case of milk cows, is another form of misrepresentation. Experienced traders seldom accept these statements and examine the animals for themselves.

The sales price for all livestock sold was announced at all auctions and the name of each buyer was announced at all except three auctions. Even though the sales price and the name of the buyer is announced at practically all auctions they are announced in such a manner at many auctions as not to be understood by the untrained ear. Many farmers are critical and suspicious of auctions for this reason. When auctioneers fail to announce the sales price and the name of the buyer, farmers are apt to infer that they are trying to "cover up" something, such as a sale to the auction operator or some friend at below market price. Also, many auctioneers in announcing the buyer call his initials or some "nickname" which is as bad as the practice of not calling names distinctly. Even though the auctioneers may be perfectly honest in this method of announcing names and prices, it should be abolished as it does leave a way open for dishonest dealings, and farmers will have more confidence in auctions and possibly consign them more livestock if prices and names are announced in such a manner as to be easily understood.

One operator reported that the name of the seller was never announced, the remaining 31 stated that the seller's name was announced if it were requested by a prospective buyer or if it were felt that the consignor's reputation was such as to add something to the sales price of the livestock. Dairy cows and heifers, breeding animals, and mules are types of animals for which the name of consignor is sometimes announced.

At most auctions there are "scalpers" present who try to purchase animals for resale on the same day at a profit. These men buy when for some reason the bidding becomes dull and resell later when bidding becomes more active. On occasions, experienced traders are able to buy animals by the head and resell them later in the day at a profit on a weight basis. Many traders also buy for resale at a later date at the same or other auctions. These men often buy low grade animals and try to unload them later at a profit on farmers who know nothing about these particular animals. In many instances an animal of doubtful quality may go through the same ring several times during one season. For example, a sale was attended at which an old gray mule was resold for the fourth time that fall according to a bystander. This practice results in inexperienced farmers finding themselves with sick or low quality livestock on their hands which may die before they are able to dispose of it, or which will not develop into productive animals. The only course left to such farmers is to resell such animals and take their loss.

Twenty-seven operators reported that consignors guaranteed a small amount of livestock. Their estimations as to the total amount of livestock guaranteed by consignors varied from 2 to 10 percent of the total sold. Five operators stated that no livestock was ever guaranteed; and 1, of the 27 stating that some were guaranteed, said that the guarantee was no good. Dairy cows and heifers, breeding animals, and mules were the usual types of animals guaranteed.

Twenty-six operators reported they gave limited guarantees on certain kinds of livestock such as milk cows and mules. At these auctions, one of the ringmen examines the animal in the sale ring with regard to age, defects, and if safely bred, and reports his findings to the buyers. The operators stated that if the ringmen failed to call a defect or otherwise made a mistake that the purchaser's money would be refunded and that the auction company would take the livestock. All operators except one disclaimed all responsibility for guarantees made by consignors, stating that they acted as agents only. Some operators reported that they guaranteed all of their privately-owned stock sold through the ring.

Only two operators reported that buyers were not allowed to buy at the barn before the sale started. One operator reported that buyers could buy at the barn before the sale started but that so far, none had. A larger percentage of livestock was purchased prior to the sale at small than at medium or large auctions. Prior to the sale, traders purchased 2.8 percent of all livestock handled at small auctions, 2.4 percent of those handled at medium auctions, 1.5 percent of those handled at large auctions, and 1.8 percent of those handled at all auctions. See table 27.

Some farmers sell before the sale starts because they either want to leave early, do not want to risk getting an uncertain price in the ring, or want the money before the sale starts for some other reason. Others are talked into selling by smooth traders who promise them "more than they can get in the ring." Farmers would do well not to sell their animals until the sale starts since the trader will give as much for the animal in the ring as he will before the sale starts. The farmer has everything

Table 27. Percentage of livestock purchased by private treaty before the sale starts, 32 auctions, Mississippi, 1943

Percent	10 small auctions	10 medium auctions	10 large auctions	32 auctions	
	number	number	number	number	percent
0	1		1	3	9.4
0.1-0.9		2	3	5	15.6
1	4	3	4	12	37.5
2	2	1		3	9.4
4		2	1	3	9.4
5	2	2	1	5	15.6
10	1			1	3.1
Total	10	10	10	32	100.0
Av. percent sold before sale	2.8	2.4	1.5	1.8	

Source: Survey of auction operators.

to gain and nothing to lose by waiting and selling in the ring. Many farmers, ignorant of the value of their animals, have sold them for "top prices" to traders before the sale started only to see them sell for much more in the ring. For example, one auction operator told of a trader purchasing a milk cow from a farmer for $42.50 and reselling the same animal in the ring later in the day for $62.50. Similar cases have been reported by other auction operators and farmers. Some auctions in this and other states have forbidden dealers or anyone else to buy in the yards prior to beginning of the sale. Perhaps this would be a good practice for all Mississippi auctions to follow.

Buying Practices

The buying of livestock at auction by the auction operator and auctioneer is one of the most criticized features of the auction market. Replies from 681 farmers regarding their attitude toward this practice showed that over half the farmers disapproved of the auctioneer buying and that about 2 out of every 5 disapproved of the auction operator buying at the sale.

In order to determine the prevalence of these practices at auctions in the State, auction operators were asked if they and their auctioneers bought at the sale. Twenty-eight operators stated that the auction management bought livestock at the sale and four that the management did not. The partners at three of the four auctions at which the management did not buy, bought livestock for their own private account. This leaves only one auction at which the operator or operators do not buy livestock during the sale. Fifty-six percent of the operators reported that the auctioneer bought for his own account, 22 percent that he did not, but could if he wanted to, and 22 percent that he was not permitted to. Since 22 percent of the operators stated that their auctioneer did not buy but could if he wanted to, it is evident that this practice could very easily become more prevalent than it has already.

Auction operators gave various reasons for buying at the sale. Seventeen reported that they bought livestock to fill orders; 13 reported that they were forced to take some at the first bid; 15 reported that they did so to keep up prices and protect the sale; 9 reported that they bought for profit; and 4 reported that they bought to stock their own farm.

Reasons given by operators for auctioneers buying are: for profit; to stock own farm; to keep up prices; to fill orders; to ship; and forced to take some on the first bid when starting bidding.

Although some of the reasons given by auction operators for buying in the ring themselves, and for allowing auctioneers to buy in the ring, are quite logical and should be given some consideration, it should also be remembered that these practices leave a way open for dishonest auctioneers or auction operators to take an unfair advantage of farmers and thus bring discredit to all auctions alike—the honest as well as the dishonest.

It has been reported that groups of dealers sometimes join together to bid up each other's stock until they are unloaded on some other person; it has also been reported that they do not compete with each other for the different kinds of livestock sold by farmers and thus bid them in at undermarket prices. It was observed at some auctions that one trader might buy all the poor cows, another all the fat cows, another all the big bulls, another all the sows, and so on, without very much active competition among different buyers.

Farmers accuse the auctioneers of working harder on dealer-consigned stock than on farmer-consigned stock. It was observed that at some auctions the auctioneer appeared to work harder on some stock than on other, but there was no way of knowing who consigned the stock since the name of the consignor was seldom announced.

While dealers have been able to join together and buy livestock below market value in many instances in the past, farmers and auction operators say that this does not happen nearly so often now. Packer buyers, big order buyers, and big out-of-state stocker and feeder buyers seem to have been patronizing auctions more and more during the past few years and this probably accounts for dealers not being able to "get together" and keep down prices as often as in the past.

Weighing Practices

Practically all livestock with the exception of milk cows and breeding stock are sold by weight. Livestock is weighed after the sale at all auctions.

Only 2 operators reported that they gave both the buyer and consignor a duplicate of the scales ticket; 2 reported that they gave only the buyer a duplicate; 8 reported that they would give either a duplicate if requested to do so; and 20 reported that they gave neither the consignor nor the buyer a duplicate of the scales ticket. Patrons at large auctions are more likely to receive a duplicate of the scales ticket than patrons of small or medium auctions. Five large operators reported that they either gave, or if requested to, would give patrons a duplicate of the scales ticket, while only four medium and two small operators reported a similar procedure.

Twenty-nine percent of the operators reported that their scales were balanced every 3 to 5 drafts. 9.7 percent that they were balanced every 6 to 15 drafts, 3.2 percent that they were balanced every 30 drafts, 29 percent that they were balanced at intervals of from 5 to 30 minutes, 12.9 percent that they were balanced every hour, 6.5 percent that they were balanced from 2 to 4 times per sale, and 9.7 percent that they were balanced once per week. Scales at small auctions were balanced much less often than at medium or large auctions. Scales were balanced four times or less per sale at four small auctions, whereas only one of the medium and none of the large auctions waited that long before balancing their scales.

Scales are not located at most auctions so as to be easily observed by patrons. They should be located in a place where patrons can watch the weighing if they desire. Auctions in some states have solved this problem by using a large-face dial scale placed in such a position as to be readily seen by all patrons in the pavilion.

A regular employee of the auction company weighs the livestock at most auctions; however, it was noticed that at some of the smaller auctions the operator would just pick up anyone to operate the scales when the sale started and that in some instances two or more persons weighed livestock the same day. Farmers have complained that at some auctions the scales were not operated by a disinterested party. For example, one farmer stated that the scales were operated by one of the big buyers and sellers.

Honest weights mean as much to farmers in dollars and cents as fair prices. High prices received by farmers can be offset by low weights, and it has been reported in other states that some operators make a practice of weighing "light" so that higher prices can be paid to producers, and thus secure their patronage. Others were reported to weigh light in order to insure the buyers nice profits and encourage them to return.[2]

The weighing practices discussed above tend to cause farmers to lose confidence in the auction as a place to market livestock. If all auctions would use registering scales and give each patron a duplicate of the scales ticket it wuold do much to inspire confidence in their weights, but this alone would not assure patrons correct weights. To dispel all doubt as to the correctness of weights, the auction company should also have the scales tested twice yearly by an official testing agency, have the scales balanced every few drafts, and have them operated by a disinterested party who is well known and respected in the community.

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[2] Randell and Mann, **Livestock Auction Sales in the United States**, Farm Credit Administration, Cooperative Research and Service Division, Bulletin 35, p. 62.

FINANCIAL DEALINGS AND PROBLEMS OF AUCTION COMPANIES

The prime purpose of any business is to return a profit. and auctions are no exception. They are beset by financial problems similar to those of other businesses. Many problems of a financial nature such as what charges should be assessed, who should be given credit, and how much additional capital to invest, arise to confront the auction operator, and the decisions he makes from time to time largely determine the success or failure of his auction.

Income, Expenses, and Profits

In most cases, it was difficult to obtain reliable information as to income and expenses of different auctions. Some auction operators kept no records of income and expenses; others combined the record of the auction with that of their other business or businesses. For these reasons, it was not possible to secure these data for a very large number of auctions; however, the desired data were obtained from seven operators. These data, which are summarized in table 28, were secured from the books of the seven auction companies, and are believed to be indicative of the major sources of income and items of expense of most auctions in the State.

Eighty percent of the income at these seven auctions came from commissions, 10 percent from trading operations, 7 percent from yardage, 2 percent from hauling, and 1 percent from feed. Income from trading operations represents the difference between the amount spent for livestock and the amount received for livestock, and does not represent profits from trading, since all trading expenses, such as hauling and feed, are charged in with the

Table 28. Average income, expense, and profit, 7 auctions, Mississippi, 1943

Items	3 small auctions	2 medium auctions	2 large auctions	7 auctions	
	dollars	dollars	dollars	dollars	percent
Income:					
Commissions	7023.32	21610.82	35826.48	19421.07	79.88
Trading operations	1261.19	....	6240.11	2323.45	9.56
Yardage[1]	160.77	2743.42	3312.18	1799.11	7.40
Hauling	1079.36	......	....	462.60	1.90
Feed	379.75	....	499.54	305.48	1.26
Total income	9904.39	24354.24	45878.31	24311.71	100.00
Expenses:					
Wages and salaries	2559.70	4335.60	8039.12	4632.75	34.13
Truck and auto expense[2]	1797.44	1351.76	4259.12	2373.50	17.49
Losses[3]	197.95	3288.23	3442.66	2007.99	14.80
Feed	1518.41	1192.84	2946.07	1833.34	13.15
Rent[4]	93.23	668.42	2093.28	829.03	6.11
Office expense[5]	360.20	403.66	872.32	518.95	3.82
Advertising	8.33	133.75	291.54	125.08	.92
Repairs & depreciation	141.54	160.34	....	106.47	.79
Miscellaneous expense[6]	350.39	959.60	2520.33	1144.46	8.43
Total expense	7027.19	12494.20	24464.44	13571.57	100.00
Profits	2877.20	11860.04	21413.87	10740.14	....

Source: Records of 7 auction companies.

[1] Two of the small auctions did not assess yardage charges. One large and one medium auction showed income from commissions and yardage charges as one figure on their books. The income from commissions and yardage charges was separated for these two auctions by multiplying the number of head of livestock the operator estimated he handled in 1943 by the yardage charge he assessed per head to get the 1943 income from yardage charges. This figure was then subtracted from the total income received from yardage and commission to get the income from commissions in 1943.

[2] Includes all hired hauling.

[3] Includes losses on resales, dead and lost animals, losses from trading and bad debts.

[4] One of the small, one of the medium, and both the large auctions rented their facilities.

[5] Includes such items as materials and supplies, telephone, telegraph, water, lights, heat, and charges for preparing income tax return.

[6] Includes such items as exchange, insurance, social security payments, entertaining, donations, taxes, veterinarian, and rebates.

general auction expenses. One of the medium auctions showed a net loss on trading operations; this item was shown under expenses in the loss column.

Wages and salaries amounted to 34 percent of all expenses; truck and auto expense, 17 percent; losses, 15 percent; feed, 14 percent; rent, 7 percent; office expense, 4 percent; advertising, 1 percent; repairs and depreciation, 1 percent; and miscellaneous expenses, 8 percent.

Losses, which is the third largest item of expense, are made up largely of losses on resales. This is a term used by auction operators to designate losses sustained on animals bought in the ring. Operators say they are forced to buy animals in many instances in order to protect their market, and that in most cases, they have to discount these animals in order to get rid of them.

In addition to the actual expenses of 7 auctions, the estimated weekly expense was obtained for 32 auctions. The average weekly estimated expense varied from less than $50 for five small auctions to over $500 for three large auctions, and averaged $172 for all auctions. The estimated weekly expense averaged $49 for small auctions, $98 for medium auctions, and $383 for large auctions. See table 29.

The weekly estimated expense only included the cash or out-of-pocket expenses and is somewhat lower than the actual average weekly expense at the auctions for which actual expenses were obtained. The average weekly expense was $261 at the 7 auctions for which actual expenses were obtained as compared to the $172 average estimated out-of-pocket expenses for 32 auctions. The difference between the two is made up largely of losses, with repairs and depreciation and other irregular expenses making up the balance.

Table 29. Average estimated expense per sale held, 32 auctions, Mississippi, 1943[1]

Expense	10 small auctions	10 medium auctions	10 large auctions	32 auctions	
	number	number	number	number	percent
Less than $50	5			5	15.6
$50-$99	4	3		8	25.0
$100-$199	1	7	1	10	31.3
$200-$299			3	3	9.4
$300-$399			2	2	6.3
$400-$499			1	1	3.1
$500 and above			3	3	9.4
Total	10	10	10	32	100.1
Av. expense	$49	$98	$383	$172	

Source: Survey of auction operators.

[1] Does not include depreciation, repairs, losses, or the value of the operator's labor and management.

Of the seven auctions for which income and expense data were obtained three were classified as small, two as medium, and two as large. The small auctions had an average profit of $2,877.20, the medium auctions an average of $11,860.04, and the large auctions an average of $21,413.87. This does not represent net profit but is the amount received by the operator or operators for their own labor and management and money invested. The figures given above do not represent what the average operator receives because half the auctions in the State are operated by partnerships of from two to four partners. However, it must be kept in mind that in most cases the operation of an auction is a part-time business and that most operators have additional income from one or more sources.

Financial Responsibility of Auctions

Auction companies perform the services of collecting from the buyer and paying the seller. Thus, failure to collect from the buyer may result in the seller going unpaid unless the auction company has ample reserves. Also, the buying of livestock by auction company may result in losses of such proportions that the company would be unable to pay the sellers.

All livestock auctions coming under the Packers and Stockyards Act are required to carry bonds in proportion to their volume of business for the protection of shippers. Five auctions in Mississippi come under this Act, and they are the only ones in the State carrying bonds. It would appear that if the federal government feels that large auctions should carry bonds to assure the protection of consignors, smaller auctions should be required to carry bonds also because, in general, they have less capital and operate on a smaller margin of profit.

Losses from bad checks or debts seem to have been kept at a minimum in 1943. Almost half the auction operators reported that they experienced no losses from bad checks during 1943. Four operators reported their losses due to bad checks were negligible; seven reported losses of less than $500; three reported losses of from $500 to $1,000; and two reported losses of $1,000 or more. One operator reported that he did not know whether or not he had any losses from bad checks or debts during the year.

In order to determine the care exercised by auction operators in regard to the financial responsibility of buyers, operators were asked what credit standards must be met before a man can buy at their auction. About half the operators reported that references were requested of new buyers. Ten operators reported that they knew all or most of the buyers and seven reported that buyers did not have to meet any credit standard before being allowed to buy. The practice followed by about half the operators of not going to the trouble of investigating buyers will result in losses sooner or later.

Although no reports were received of auctions failing to pay consignors during the past year, some auction companies did sustain losses, and if these losses had been serious, consignors at some auctions would have doubtless suffered losses. Losses to auction companies from bad checks bad debts, and animals purchased, are light during periods of prosperity, but during periods of declining prices losses of this kind arise and often result in serious losses to auction operators and consignors. For these reasons it appears that all auction companies should be required to carry bonds to protect their consignors.

Marketing Charges

The number of services for which charges were assessed varied from one to four at different auctions. Commissions, yardage charges, insurance premiums, and weighing charges were the four charges assessed. Only 2 of the 34 auctions for which these data were obtained made all four charges.

All auctions in the state based their commission charges on a percentage of gross sales. Thirty auctions charged 5 percent commission, two charged 4 percent commission, and two based their charges on the total value of animals consigned by each individual. One of these charged 5 percent commission for consignments of less than $500, 4 percent for consignments of from $500 to $1,200, and 3 percent for consignments of over $1,200; the other charged 5 percent for consignments of less than $500, 4 percent for consignments of from $500 to $1,000, and 3 percent for consignments of over $1,000.

Sixteen auctions assessed yardage charges; of these 11 assessed a straight yardage charge of 10 cents per animal sold. Three auctions charged 25 cents each for cattle and 15 cents each for other livestock, and two charged a straight rate of 25 cents per animal. Insurance premiums were charged by five auctions. Four charged 2 cents per head, and one charged 1 cent per head. Weighing charges of 5 cents per head were assessed by two auctions.

The majority of auctions made either a single charge of 5 percent commission or 5 percent plus 10 cents yardage. Sixteen auctions made no charge other than the 5 percent commission; 10 charged 5 percent commission plus 10 cents yardage. These two groups made up about three-fourths of the auctions in the State.

Charges assessed for selling mules and other workstock were usually different from the charges assessed for selling livestock. The commission charged for selling mules was on a per head basis at all except six auctions. The charges per head ranged from $1.00 to $3.75, with the majority charging $2.50. In addition, 13 auctions assessed yardage charges of from 10 to 50 cents per head.

The majority of auctions assess no charge on "pass-outs," that is, the animals on which the consignor refuses the last bid. Twenty-two operators reported that they assessed no charge on "pass-outs," seven reported that they assessed the regular yardage charge, two reported that they charged $1.00 on mules, and one reported that 25 cents was charged on mule "pass-outs."

Commission charges assessed by auctions are higher in Mississippi than in adjoining states and in the nation as a whole. Sixty percent of the auctions in Louisiana charge 4 percent commission as compared to 32 percent that charge 5 percent. One auction in Louisiana charges 3 percent commission.[1] Referring to commission charges at a group of auctions which they studied in Arkansas, Osgood and White stated that "four percent was the most common rate charged."[2]

Randall and Mann, in their study of livestock auctions in the United States, found that commission charges varied from 1 to 5 percent at 89 auctions which computed their charges as a percentage of gross sales and that 58 percent charged 3 percent and 16 percent charged 4 percent. Charges were computed on a per head basis at 83 auctions. The most common rates charged per head were: cattle $1.00, calves 50 cents, pigs 25 cents, heavy hogs 50 cents, and sheep 25 cents.[3]

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[1] Baker, J. M., **Louisiana Livestock Auctions,** Louisiana Agricultural Experiment Station, Mimeographed Circular No. 10, 1940, p. 9.

[2] Osgood, O. T. and White, J. W., **Livestock Auctions in Arkansas,** Arkansas Agricultural Experiment Station Bulletin No. 439, 1943, p. 10.

The computation of selling charges on a per head basis would be more equitable than basing charges on a percentage of gross sales value. The present system of assessing charges penalizes producers of good livestock by forcing them to pay three to four times as much for the same services as producers of poor livestock. This causes many producers of good grade livestock to sell through other outlets. If selling charges were computed on a per head basis, a larger proportion of the good livestock produced in Mississippi would, in all probability, be sold through auctions. Another advantage of this method of computing charges is that it would do much to stabilize the income of auction companies from year to year. This would be important during periods of declining prices because expenses usually fall slower than prices. That is, the income of auction companies would be falling faster than their expense and this could prove disastrous in some cases.

In order to determine whether or not it would pay auction operators to cut their commission charges farmers were asked if they would sell more livestock through auctions if selling charges were smaller. Of the 657 farmers reporting, 465 or 71 percent reported in the affirmative. Thus, it appears that if Mississippi auction operators would decrease their charges until they are in line with those in other states, the resulting increase in the number of animals consigned might more than offset the decreased income per animal sold. That is, by selling more animals at a smaller charge per head, their profits would probably increase rather than decrease.

Selling charges are higher at auctions than at public terminal markets for most classes of livestock, the only exception being small animals of low value. Also selling charges per head are decreased at public terminal markets for carload shipments; whereas, selling charges per head remain constant at most auctions. This causes selling charges for all animals in carload lots, except those of extreme low value, to be lower at public terminal markets than at auction markets.

Selling charges at auctions for different qualities of animals of average weight, when sold singly or in small numbers, exceeded charges at public terminal markets for all livestock except goats and sheep. See table 30. It will be observed that the auction charges for selling low

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[3] Randall, C. G., and Mann, L. B., **Livestock Auction Sales in the United States**, Farm Credit Administration, Cooperative Research and Service Division, **Bulletin 35, p. 65.**

Table 30. Comparison of selling charges at Mississippi auctions[1] with those at public terminal markets, 1943.

Class of livestock and selling charges	Charge per head	
	1 head	Single deck car by rail
	dollars	dollars
Calves, (low quality, average weight 250 pounds, value $18.98)[2]		
Auction, 5 percent of gross value	.95	.95
Terminal public market	.75	.45
Calves (medium quality, average weight 300 pounds, value $28.59)[2]		
Auction, 5 percent of gross value	1.43	1.43
Terminal public market	1.25	.48
Calves (best quality, average weight 350 pounds, value $42.35)[2]		
Auction, 5 percent of gross value	2.12	2.12
Terminal public market	1.25	.51
Cows (low quality, average weight 500 pounds, value $28.40)[2]		
Auction, 5 percent of gross value	1.42	1.42
Terminal public market	1.35	.79
Cows (medium quality, average weight 750 pounds, value $55.65)[2]		
Auction, 5 percent of gross value	2.78	2.78
Terminal public market	1.35	.98
Cows (best quality, average weight 1,000 pounds, value $95.80)[2]		
Auction, 5 percent of gross value	4.79	4.79
Terminal public market	1.35	1.23
Hogs (lightweight, average weight 130 pounds, value $15.02)[2]		
Auction, 5 percent of gross value	.75	.75
Terminal public market	.40	.23
Hogs (medium weight, average weight 210 pounds, value $26.36)[2]		
Auction, 5 percent of gross value	1.32	1.32
Terminal public market	.40	.30
Hogs (heavyweight, average weight 300 pounds, value $36.66)[2]		
Auction, 5 percent of gross value	1.83	1.83
Terminal public market	.40	.35
Sheep (average value $5.70)[2]		
Auction, 5 percent of gross value	.29	.29
Terminal public market	.35	.25
Goats (average value $2.58)[2]		
Auction, 5 percent of gross value	.13	.13
Terminal public market	.35	.25

Source: Compiled from information received from auction operators, the South Memphis Stockyards Co., and the Burnette-Carter Co., Livestock Commission Agents, South Memphis Stockyards.

[1] Almost half the auctions in the State make a single charge of 5 percent commission. Total marketing charges for auctions making additional charges can be calculated by adding these charges to the commission charges given above.

[2] The value per head is based on the average price paid as auctions. See table 43.

value animals do not exceed charges at public terminal markets greatly but that selling charges for high value animals are much higher.

In comparing the total cost of marketing at auctions and public terminal markets, it must be remembered that some auctions make additional charges for yardage, insurance, and weighing, and that transportation cost is higher for most farmers when selling through public terminal markets. The number and value of animals to be sold and the distance from each market are the factors which determine at which market the total marketing charges are lowest. The prices that can be expected to be paid at each of the two markets is the other important factor to be considered in finally determining which market to use.

PRICES

The prices reported in this bulletin were computed from the sales slips or other records of 13 auction companies. Therefore, the prices shown are averages of actual prices received by farmers for livestock sold through auctions except that selling charges have not been deducted. In comparing prices at auctions with those offered by dealers, shippers, and slaughtering establishments, farmers should deduct selling charges assessed at auctions in order to arrive at net prices.

Prices received for different grades of livestock cannot be shown because they are not sold on the basis of grades at auctions in Mississippi. Therefore, in order to show the relationship between quality and price, the prices received for each kind of livestock were arranged in order of magnitude and divided into three groups: (1) the upper 25 percent of the prices were averaged and considered as the prices received for the best quality animals; (2) the middle 50 percent were averaged and considered as the prices received for the medium quality animals; and (3) the lowest 25 percent were averaged and considered as the prices received for the poorest quality animals.

In tabulating prices, 1 sale day was used per month in 1943 for each of the 13 auctions. Prices of all animals sold on each sales day, for which the records showed the kind and class, were tabulated. A total of 21,743 individual prices were tabulated, of which 6,725 were calves sold by weight; 5,168 cattle sold by weight; 4,166 cows, heifers and cows and calves sold by head; 3,688 hogs; 1,078 goats and sheep, and 918 workstock.

Prices Received at Auctions[1]

Prices received for all classes of livestock were highest in the spring and lowest in the fall. This difference in prices is due in part to the fact that, in general, farmers in Mississippi buy in the spring and sell in the fall. That is, many farmers buy feeder, stocker and breeder animals in the spring in competition with other buyers and thereby force prices up; whereas, farmers sell large numbers of animals in the fall and buy very few other than replacements for culls. Prices of livestock also decline in the fall because of the prospective cost of carrying them through the winter, and rise in spring because of their having been carried through the winter—the period in which feeding cost is highest.

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[1] For the monthly prices of the different qualities of livestock, see table 43 in Appendix.

Average good quality livestock sold for as much as two or three times that of average poor quality livestock. Farmers should observe the differences in these prices and endeavor to produce better quality animals. The cost of producing a good quality animal does not greatly exceed the cost of producing a low quality animal, and since the average prices received for good quality animals are much higher than prices received for low quality animals, farmers producing good quality animals should make higher profits than farmers producing low quality animals.

Prices at Small, Medium, and Large Auctions

Highest prices were paid at large auctions for all classes of livestock. Lowest prices were paid at small auctions for cattle sold by the head and for hogs; lowest prices were paid at medium auctions for cattle sold by weight. See table 31. One would expect to find the lowest prices for all classes of livestock at small auctions, and in general, this is the case. The three medium auctions from which price data were obtained are all located in dairy regions, and most of the animals sold by weight were of dairy origin. Some of the small auctions were located in areas that produced considerable beef cattle

Table 31. Average annual prices received for livestock, by size of auction, 13 auctions, 1943[1]

Kind of livestock	5 small auctions	3 medium auctions	5 large auctions
	dollars	dollars	dollars
Sold by head:			
Cow and calf	64.55	67.37	74.17
Cow	56.38	60.04	63.42
Heifer	31.73	32.60	35.79
Sold by weight:			
Cows	7.00	6.83	7.84
Heifers	9.40	9.16	10.44
Bulls	8.62	8.72	8.95
Steers	9.14	9.02	10.79
All calves	9.31	8.28	10.24
All hogs	11.80	11.81	12.09

Source: Records of 13 auction companies.

[1] Comparisons were not made for sheep, goats, and workstock because of the small number of price quotations for small and medium auctions.

and since beef cattle sell for higher prices per hundred pounds, the average prices received for cattle sold by weight at small auctions were higher than at the medium auctions.

The prices for all livestock at the small and large auctions are considered to be comparable because they were located in similar livestock producing areas. For this reason, prices at large and small auctions will be compared to show the effect the size of auction has on prices received for livestock.

Consignors received $9.62 more per cow and calf, $7.04 more per cow, and $4.06 more per heifer at large than at small auctions. Consignors to large auctions received an average of 84 cents more per hundred pounds for cows, $1.04 more for heifers, 33 cents more for bulls, $1.65 more for steers, 93 cents more for calves, and 29 cents more for hogs than consignors to small auctions. In other words, producers received about 12 percent more for cattle and about 2.5 percent more for hogs at large than at small auctions.

Two factors serve to cause average prices to be higher at large than at small auctions, the first of which brings about the second. First, there are more big buyers at large than at small auctions, and the more intense competition causes prices to be higher. Second, a better grade of livestock is consigned to large auctions than to small auctions because of the larger number of buyers. Many producers will not consign their better livestock to small auctions because not enough good livestock is consigned to them to make it profitable for big buyers to attend and pay the premium that good livestock deserves over ordinary livestock.

An observation of table 32 will bear out the statements made in the preceding paragraph. Packer buyers bought slightly over half the livestock at large auctions as compared to about 15 percent at small auctions. Traders and farmers bought most of the livestock at small auctions, with the auction operator buying a considerable amount. On a percentage basis, local dealers or traders bought about twice as many animals at small as at large auctions.

The extent to which consignors reject the last bid on their livestock should give some indication of the degree to which prices are satisfactory at the different size auctions. Consignors at small auctions rejected the highest bid on 2.9 percent of the livestock going through

Table 32. Estimated percentage of livestock bought by different groups, 32 auctions, Mississippi, 1943

Buyer	Cattle and calves				Hogs and pigs			
	10 small auctions	10 med. auctions	10 large auctions	32 auctions	10 small auctions	10 med. auctions	10 large auctions	32 auc.
Traders[1]	36.7	29.0	18.6	23.1	33.2	23.4	15.5	19.2
Packers[2]	14.6	40.7	51.3	45.0	17.1	45.7	50.6	46.2
Farmers	42.0	23.1	24.5	25.8	37.5	27.5	29.7	29.8
Auction company	6.7	7.2	5.6	6.1	12.2	3.4	4.2	4.8
Total	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0

Source: Survey of auction operators.

[1] Includes order buyers not buying for packers.

[2] Includes order buyers buying for packers and local butchers.

the ring as compared to 1.0 percent at medium auctions, and 0.6 percent at large auctions. This would seem to indicate that prices are more satisfactory at large than at medium auctions, and at medium than at small auctions. See table 33.

Prices at Auctions Compared with Prices at other Markets

It is impossible to compare prices at auctions with those at public terminal markets because of the different methods of sale involved. Livestock are sold in groups on the basis of grade at public terminal markets, whereas, they are usually sold individually and never on the grade basis at auctions in Mississippi.

It was found that the only available method of comparing prices at auctions with those at other markets was to compare prices received for all cattle and all hogs at auctions with the average price received by farmers as reported by farmers to the United States Department of Agriculture. It is assumed that some of the reporting farmers had sold livestock at all the different types of markets and that the average price reported received by farmers is an average of the prices paid at all markets.

Table 33. Percentage pass-outs are of total livestock handled, 32 auctions, Mississippi, 1943[1]

Percent pass-outs	10 small auctions	10 medium auctions	10 large auctions	32 auctions	
	number	number	number	number	percent
Less than 1		5	7	13	40.6
1	3	3	2	8	25.0
2	3	1	1	5	15.6
2.5				1	3.1
3		1		1	3.1
5	4			4	12.5
Total	10	10	10	32	99.9
Av. percentage pass-outs	2.90	1.01	.62	.93	

Source: Survey of auction operators.

[1] Animals on which the seller rejects the highest bid.

Prices received for cattle were higher at auctions during the first 5 months of the year and lower during the last 7 months of the year than prices reported received at all markets. The average annual price of $9.53 per hundred pounds received for cattle at auctions was slightly lower than the average price of $9.62 received at all markets. This is a difference of about one percent. See table 34.

Prices received for hogs at auctions were lower than the prices reported by farmers at all markets in all months except February. The average price of $11.89 per hundred pounds received for hogs at auctions was about 5 percent lower than the $12.49 reported received by farmers at all markets.

Before it can be stated that prices at auctions are lower than those at other markets, the method by which average prices received by farmers at all markets are computed should be examined. The United States Department of Agriculture has a number of farmer reporters

Table 34. Comparison of average prices received at auctions with the average of those received by farmers at all markets by months, 1943[1]

Month	Cattle		Hogs	
	Auctions	All markets	Auctions	All markets
	dollars	dollars	dollars	dollars
January	9.72	9.20	12.42	12.80
February	10.46	9.80	12.92	12.80
March	11.25	10.00	12.91	13.20
April	12.51	10.20	12.64	13.30
May	11.03	10.50	12.50	12.90
June	9.95	10.30	11.89	12.30
July	9.32	10.20	11.83	12.20
August	8.90	9.80	11.95	12.40
September	8.74	9.50	11.80	12.40
October	7.76	9.20	12.16	12.40
November	6.80	8.30	10.33	12.00
December	7.93	8.40	9.35	11.20
Year	9.53[2]	9.62[2]	11.89[2]	12.49[2]

Source: Records of 13 auction companies and the April 1943, July 1943, October 1943, and January 1944 issues of **Crops and Markets**, United States Department of Agriculture.

[1] Prices received by farmers as of the 15th of the month as reported by farmers to the United States Department of Agriculture.

[2] Simple average. The weighted yearly average was not given for all markets, therefore the yearly average at auctions and all markets was calculated as a simple average in order to make the yearly prices comparable.

scattered over the State who report on various aspects of farming. Prices received for crops and livestock is one of the items reported by farmer reporters.

As the poor or average farmer seldom goes to the trouble of answering questionnaires or filling out reports, it is thought that most farmer reporters are among the better farmers in their communities. In general, better farmers produce better livestock than poor or average farmers, and it is, therefore, believed that prices reported by farmer reporters are for better livestock than the average grade of livestock sold in Mississippi.

After receiving the farmers' reports, the state statistician calculates the average prices received by farmers, taking into account prices received in previous months and prices received at public terminal markets during the same month. In other words, prices reported by farmers are adjusted with an eye to past as well as present prices. An examination of prices received by farmers will show prices at auctions fluctuating to a greater extent. That is, the state statistician appears to have adjusted prices reported by farmers so as to smooth out extreme fluctuations.

Since prices declined during the last two-thirds of the year, the apparent adjusting of prices to smooth out extreme fluctuations caused the average prices received by farmers at all markets to appear higher than the average prices received at auctions which took all fluctuations of prices into account. With this in mind, it seems that prices at auctions compare rather favorably with those at all markets in the State.

FARMER ATTITUDES TOWARD AUCTIONS

In order to determine the relative importance of auctions in the livestock marketing system of Mississippi and the attitude of farmers toward auctions, it was found necessary to obtain a number of schedules from farmers. These schedules, 929 in number, were secured through the cooperation of 56 Vocational Agriculture teachers and their students.

About 25 percent of the 929 farmers reporting sold no livestock in 1943 and slightly over two-fifths bought none during the same period. Of the 700 farmers selling livestock in 1943, 179 or 25.6 percent sold one or more head through auctions, and 77 or 14.3 percent of the farmers buying livestock in 1943 bought one or more head through auctions. For the purpose of analysis, farmers were divided into small, medium, and large producers. Farmers selling less than 5 animals were classed as small producers, those selling from 5 to 20 as medium producers, and those selling 20 or more as large producers. Of the 929 farmers reporting, 510 or 54.9 percent were classified as small producers, 305 or 32.8 percent as medium producers, and 114 or 12.3 percent as large producers.

Where Farmers Sell and Buy Livestock

Auction markets are the most important single outlet for livestock in Mississippi, according to sales reports of 929 farmers. These farmers sold a total of 11,804 livestock in 1943, of which 36.3 percent were sold through auctions, 17.8 percent to other farmers, 17.8 percent to dealers or truck buyers, 13.8 percent to packing plants, 10.8 percent through terminal public markets, and 3.5 percent through other outlets. See table 35.

A greater percentage of cattle was marketed through auctions than was the case of hogs. About 44 percent of the cattle was marketed through auctions as compared to approximately 30 percent of the hogs. Dealers and other farmers were the second and third most important outlet for cattle whereas, other farmers and dealers were the second and third most important outlet for hogs. A greater percentage of hogs was sold to packing plants and through public terminal markets than in the case of cattle.

Large producers sold a greater percentage of their livestock through auctions than did medium producers, and medium producers sold a greater percentage of their livestock through auctions than did small producers. The same was true for both packing plants and public terminal markets. Small producers sold a greater percentage of their livestock to dealers and other farmers than did medium producers and medium producers sold a greater percentage of their livestock through each of these sources than did large producers. See table 36.

Table 35. Number and percentage of livestock sold through various Marketing agencies, 929 farmers, Mississippi, 1943[1]

Agencies sold through	Cattle and calves		Hogs and pigs		Total[2]	
	No.	Pct.	No.	Pct.	No.	Pct.
Terminal public market	452	8.14	824	13.18	1276	10.81
Packing plants	695	12.52	938	15.00	1633	13.83
Dealers or truck buyers	1155	20.80	940	15.04	2095	17.75
Auctions or sale barns	2427	43.71	1862	29.78	4289	36.34
Farmers	715	12.88	1383	22.12	2098	17.77
Other	108	1.95	305	4.88	413	3.50
Total	5552	100.00	6252	100.00	11804	100.00

Source: Vocational Agriculture high school survey.

[1] Of this group, 229 sold no livestock.

[2] Sheep were not included because of their relative unimportance in Mississippi.

The fact that 13.5 percent of the small producers, 25.6 percent of the medium producers, and 55.3 percent of the large producers sold livestock through auctions in 1943, further accentuates the effect which the number of animals the producer sells has on the marketing outlet chosen.

A summary of reports made by 607 producers who reported on how the livestock they sold was moved from the farm in 1943 shows that 58 percent of the livestock was moved by the farmer in his own truck or trailer, 14 percent by truckers hired by the farmer, 24 percent by the buyer, and 4 percent by wagon or on foot. Sixty-one percent of the livestock sold by small producers was moved from the farm by buyers and only 20 percent by farmers in their own or hired trucks and trailers; 54 percent of the livestock sold by medium producers was moved by buyers and 36 percent by farmers in their own or hired trucks and trailers; and 14 percent of the livestock sold by large producers was moved by buyers and 71 percent by farmers in their own or hired trucks and trailers. Small producers moved 18 percent of the livestock they sold from the farm by wagon or on foot, medium producers 10 percent, and large producers 2 percent. See table 37.

Table 36. Number and percentage of livestock[1] sold through various marketing agencies by size of producer,[2] 929 farmers, Mississippi, 1943.

Agencies sold through	Size of producers					
	Small		Medium		Large	
	No.	Pct.	No.	Pct.	No.	Pct.
Terminal public markets	20	3.25	142	5.10	1114	13.26
Packing plants	9	1.46	98	3.52	1526	18.16
Dealers or truck buyers	267	43.34	900	32.31	928	11.05
Auctions or sale barns	72	11.69	495	17.77	3722	44.29
Farmers	221	35.88	1044	37.49	833	9.91
Others	27	4.38	106	3.81	280	3.33
Total	616	100.00	2785	100.00	8403	100.00

Source: Vocational Agriculture high school survey.

[1] Cattle and hogs. Sheep were not included because of their relative unimportance in Mississippi.

[2] The 510 farmers selling less than 5 livestock were classified as small producers, the 305 selling from 5 to 20 as medium producers, and the 114 selling 20 or more as large producers.

Farmers buy more livestock directly from other farmers than from any other source; purchases from auction markets were a close second. The 537 farmers who reported buying livestock in 1943 bought 37 percent of their purchases from other farmers, 33 percent through auctions, 15 percent from dealers, 8 percent from packing plants, 4 percent through public terminal markets, and

Table 37. Transportation of livestock[1] from farms, 929 farmers,[2] Mississippi, 1943.

Method of transportation	Farmers selling							
	1-4		5-19		20 and above		All farmers	
	No.	Pct.	No.	Pct.	No.	Pct.	No.	Pct.
By farmer in own truck or trailer	39	7.0	347	17.0	5756	71.4	6142	57.6
By hired truckers	75	13.4	395	19.3	1010	12.5	1480	13.9
By the buyer	342	61.2	1108	54.1	1134	14.1	2584	24.2
By wagon or on foot	103	18.4	196	9.6	163	2.0	462	4.3
Total	559	100.0	2046	100.0	8063	100.0	10668	100.0

Source: Vocational Agriculture high school survey.

[1] Cattle and hogs. Sheep were not included because of their relative unimportance in Mississippi.

[2] Of the 700 farmers selling livestock in 1943, 607 filled out this section.

3 percent through other sources. See table 38.

Farmers purchased more cattle through auctions and more hogs from other farmers than from any other source. On a percentage basis almost twice as many cattle as hogs were purchased through auctions, almost the same proportion for each was purchased from other farmers. Twice as many hogs as cattle were purchased from dealers; whereas, the opposite was true in the case of public terminal markets. No cattle were purchased from packing plants as compared to 14 percent for hogs.

As was the case in selling livestock, the number of animals to be purchased has much to do with what market is patronized. In each instance, as the number of head of livestock purchased increased, the percentage of purchases from other farmers and dealers or truck buyers decreased and the percentage of purchases from auctions, packing plants, and terminal public markets increased. See table 39.

Table 38. Number and percentage of livestock bought through various marketing agencies, 929 farmers, Mississippi, 1943[1]

Agency bought through	Cattle and calves		Hogs and pigs		Total[2]	
	No.	Pct.	No.	Pct.	No.	Pct.
Terminal public market	169	5.90	76	2.27	245	3.95
Packing plants	....	......	470	14.06	470	7.57
Dealers or truck buyers	280	9.77	672	20.11	952	15.33
Auctions or sale barns	1199	41.83	829	24.81	2028	32.67
Farmers	1056	36.85	1251	37.43	2307	37.16
Others	162	5.65	44	1.32	206	3.32
Total	2866	100.00	3342	100.00	6208	100.00

Source: Vocational Agriculture high school survey.

[1]Of this group, 392 bought no livestock.

[2]Sheep were not included because of their relative unimportance in Mississippi.

The data analyzed in this section can be summarized by saying (1) that the smaller producers sell and buy most of their livestock to or from other farmers and dealers or truck buyers at the farm, because in most cases they either do not have transportation facilities or else find it unprofitable or too much trouble to hire transportation; and (2) that the larger producers sell and buy the majority of their livestock through auctions

Table 39. Number and percentage of livestock[1] bought through various marketing agencies by number bought,[2] 929 farmers, Mississippi, 1943

Agencies bought through	Number of animals bought in 1943					
	1-4		5-19		20 or more	
	No.	Pct.	No.	Pct.	No.	Pct.
Terminal public markets	12	1.48	18	1.97	215	4.79
Packing plants	....	......	....	....	470	10.48
Dealers or truck buyers	109	13.46	170	18.62	673	15.01
Auctions or sale barns	63	7.78	158	17.31	1807	40.29
Farmers	596	73.58	516	56.52	1195	26.64
Others	30	3.70	51	5.58	125	2.79
Total	810	100.00	813	100.00	4485	100.00

Source: Vocational Agriculture high school survey.

[1]Cattle and hogs. Sheep were not included because of their relative unimportance in Mississippi.

[2]Of the 537 farmers buying livestock in 1943, 388 bought less than 5 head, 113 bought from 5 to 20 head, and 36 bought 20 head or more.

and other off-farm markets because they either have adequate transportation or find it profitable to hire transportation.

Why Farmers Sell Through Auctions

In order to determine why farmers of Mississippi have made the auction their predominant livestock market farmers were asked to give their reason or reasons for selling through auctions. Of the 929 farmers returning schedules, 262 answered this question giving a total of 295 reasons for selling through auctions. While the total of 262 answers to this question out of 929 schedules may seem small at first, it must be remembered that only 179 of these farmers sold through auctions in 1943 and that probably not many of the others had sold through auctions in former years.

Higher prices was by far the most important reason given by farmers for selling through auctions, almost two out of every five giving this reason. Closeness or convenience made up 13 percent of the reasons given for selling through auctions; a ready market (can sell any and all kinds of livestock), 10 percent; only market available, 7 percent; fair prices, 7 percent; more buyers and competition, 5 percent; best market available, 2 percent; can buy at the same time, 2 percent; livestock can be carried home if prices are unsatisfactory, 2 percent; and other reasons 4 percent. Ten percent of the farmers reported that they had no particular reason for selling through auctions. See table 40.

Criticisms of Auctions

Although the farmers of Mississippi market more livestock through auctions than any other single outlet, they are still very critical of them in numerous respects. The most common criticism made was the danger of spreading diseases. The danger of spreading diseases made up 34 percent of the 462 criticisms made by the 353 farmers reporting; marketing charges too high, 14 percent; rough treatment of animals, 10 percent; low prices, 5 percent; unethical practices of auction operators and buyers, 5 percent; uncertain quality of animals purchased, 4 percent; cannot understand auctioneer, 3 percent; auctioneer bidding, 2 percent; no law governing auctions, 2 percent; inadequate facilities, 2 percent; pens not sanitary, 1 percent; auction operator bidding, one percent; other criticism, 6 percent; and no criticism, 13 percent. It is important to note that of the farmers reporting, only about one

Table 40. Reason given for selling through auctions, 262 farmers, Mississippi, 1943[1]

Reason	Number	Percent
Higher prices	114	38.64
Convenient	38	12.88
Ready market	29	9.83
Only market available	21	7.12
Fair prices	20	6.78
More buyers and competition	14	4.75
Best market available	7	2.37
Can buy at the same time	6	2.03
Livestock can be carried home if prices are unsatisfactory	5	1.70
No particular reason	30	10.17
Other reasons	11	3.73
Total	295[2]	100.00

Source: Vocational Agriculture high school survey.

[1] Of the 929 farmers returning schedules, 262 answered this question.

[2] Some farmers gave more than one reason.

out of six were completely satisfied with auctions as they are now operated. See table 41.

With regard to the spreading of diseases, farmers stated that they had bought livestock at auctions only to have them develop some kind of disease within a few days. They also brought out the fact that some operators make no attempt to keep their yard and pens clean and sanitary, and that the yard and pens at these auctions are muddy much of the time, which is very conducive to the spreading of diseases.

Farmers objected to the rough treatment of livestock for humane reasons and because of the danger of maiming or causing the animals to become sick. There is one other important reason why auction operators should not allow rough treatment of animals. The bruised spots on livestock, especially hogs, are usually a total loss when animals are slaughtered soon after being subjected to beating such as they receive at some of these markets.

The inadequacy of facilities mentioned by several farmers included the lack of pens so that too many animals are crowded together in one pen; the lack of seating space for buyers and sellers so that in many instances farmers cannot see the animals as they go through the ring; the lack of water for animals that have to stand for several hours before being sold; and lack of feed for those animals that have to stay overnight.

Some of the most important unethical practices listed by farmers as being followed or allowed by some auction

Table 41. Criticisms of livestock auctions, 353 farmers, Mississippi, 1943[1]

Criticism	Number	Percent
Spreading of diseases	155	33.55
Marketing charges too high	65	14.07
Rough treatment of animals	48	10.39
Low prices	22	4.76
Unethical practices of auction operators	21	4.55
Uncertain quality of animals purchased	17	3.68
Can't understand auctioneer	15	3.25
Auctioneer bidding	8	1.73
No law governing auctions	8	1.73
Inadequate facilities	8	1.73
Pens not sanitary	6	1.30
Auction operator bidding	5	1.08
No criticisms	60	12.99
Other criticisms	24	5.19
Total	462[2]	100.00

Source: Vocational Agriculture high school survey.

[1] Of the 929 farmers returning schedules, 353 filled out this section.

[2] Some farmers gave more than one criticism.

operators are: Sale operators take up too much time on company-owned stock and bid on their own stock; the scales are not operated by disinterested party; there appears to be too much understanding between some auctioneers and buyers; and dealers are favored over farmers in that they receive a reduction in commission charges in some instances and appear to receive higher prices for their animals.

Suggestions for Improving Auctions

Since farmers are directly concerned with auctions, they, more than anyone else, should be in position to make suggestions as to how auctions could be improved. With this in mind, farmers were asked to state any ideas they might have as to how auctions could be improved. Reports containing 397 suggestions were received from 314 farmers.

Farmers thought that some form of disease control program would do more to improve conditions at auctions than any other change that could be made. Other important suggestions made by farmers for improving auctions are: Lower the commission and other charges; handle the animals with more care; provide better auctioneers; keep the facilities more sanitary; and provide better facilities. See table 42.

Table 42. Suggestions for improving auctions, 314 farmers, Mississippi, 1943[1]

Suggestions for improving auctions	Number	Percent
Some form of disease control	153	38.54
Lower commission and other charges	35	8.82
Handle animals more carefully	23	5.80
Better auctioneers	17	4.28
Keep auctions more sanitary	16	4.03
Provide better facilities	12	3.02
Have auctions readily accessible to all communities	12	3.02
Auctioneer should speak more distinctly	11	2.77
Auctioneer should not bid	6	1.51
Have seller give information about his livestock	6	1.51
Advertise the auction more	5	1.26
Provide better means of transporting livestock to auctions	5	1.26
No suggestions	59	14.86
Other suggestions	37	9.32
Total	397[2]	100.00

Source: Vocational Agriculture high school survey.

[1] Of the 929 farmers returning schedules, 314 filled out this section.

[2] Some gave more than one suggestion for improving auctions.

In order to determine how farmers would react if some form of state regulation of auctions were in force and if such regulation would not also react to benefit auction companies, farmers were asked if they would sell more livestock through auctions if some form of state regulation such as disease control were in force. Over four-fifths of the 642 farmers reporting stated that they would sell more livestock through auctions if such regulations were in force, with only 16.5 percent replying in the negative. These figures seem to indicate that it would pay auction operators to ask for regulation to help keep down diseases rather than wait for pressure to come from other groups.

A number of auction operators indicated that they were in favor of the State regulating auctions in order to keep down diseases. These operators realize that effective disease control is essential to the sound development of the livestock industry in Mississippi, and that many auction operators will not go to the expense of taking precautionary measures against diseases unless they are forced to do so.

REGULATION OF LIVESTOCK AUCTIONS IN OTHER STATES[1]

Although a number of states have enacted legislation designed to regulate livestock auctions during the past few years, approximately one-third of the states still have no laws or regulations governing them. Sixteen of the 46 states reporting indicated that they had no laws or regulations in force. Of this 16, four reported having no regular livestock auctions and one reported having such a few that regulations were considered unnecessary. Of the 30 states having one or more regulations affecting auctions, those in 18 states are regulated by specific laws enacted to control them or by specific regulations set up to govern them by the State Livestock Sanitary Board or its equivalent. The auctions in the remaining 12 states are regulated by laws and/or regulations applying to all stockyards.

Administration of laws and/or regulations applying to auctions is delegated to some state administrative body, usually the Livestock Sanitary Board. The agency in charge of the administration of the law is given the authority to make further rules and regulations in order to carry out the act. to issue licenses, usually for a year, and to renew them or revoke them for cause.

Five auctions in Mississippi, together with a number of auctions in other states, come under Federal supervision under authority granted the Federal Government by the Packers and Stockyards Act (42 Statutes, 159 as amended). The most important provision of the Packers and Stockyards Act concerning stockyards and auctions are as follows: (1) Each auction must be bonded to secure the performance of obligations; (2) each auction operator must keep certain records and make an annual report to the Director of the Office of Food Distribution; (3) scales must be tested by competent agencies at suitable intervals (at least every 6 months in Mississippi); (4) each auction company must file a schedule of its commission and other charges with the Secretary of Agriculture and must give 10 days notice before they can be changed.

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[1] There is no state regulation of auctions in Mississippi except in the case of two auctions which are located in a Bang's free county. All breeding cattle more than 6 months of age leaving these two auctions must pass an agglutination test for Bang's disease.

Sanitary Regulations

Facilities: Ten states provide for the approval of facilities by the state veterinarian or some other state official before a license is issued to the auction company. Floors of concrete or other impervious material in all pens used for swine is required by 12 states.

Cleaning and disinfecting: In 24 states, all or part of the pens, alleys, and sales rings must be cleaned and disinfected after each sale or as required by the administrative agency under the supervision of an approved veterinarian or as provided for by the administrative agency. Twelve states provide for the cleaning and disinfecting of trucks under the supervision of an approved veterinarian or as provided for by the administrative agency.

Diseased animals: Seventeen states have regulations which make it unlawful to consign and/or receive animals known to be diseased and/or exposed to diseases.

Inspection and vaccination: Twenty-five states require all animals consigned to auctions to be inspected by an approved veterinarian with the exception in some states of slaughter animals. In 24 states, all swine consigned to auctions, except for immediate slaughter, must be vaccinated for cholera unless accompanied by a certificate of vaccination. Eight states require all dairy and breeding animals consigned to auctions, except for immediate slaughter, to be tested for Bang's disease unless accompanied by a certificate signed by a qualified veterinarian.

Administrative Regulations

Licensing of operators: Twenty-five states require auction operators to have a license or permit before they can operate. The fees charged for these licenses ranged from no charge to $125, and in most cases must be renewed annually.

Bonding of operator: Bond must be carried by auction operators in 19 states to insure faithful performance of obligations. In those states that require all auctions to carry the same value bond, the required amount varied from $1,000 to $10,000. Several states varied the amount of the bond, depending on the volume of business.

Keeping of records: Records of each transaction must be kept by auction operators in 21 states. Most states require the record to include the date of transaction, the name and address of buyers and sellers, and the number and species of animals.

Weighing: Regular inspection and testing of scales is required by 11 states. The frequency of testing varies from 3 to 6 months. Bonded weightmasters are required by three states and one state makes it unlawful for the weigher to buy at the auction where he is employed.

Title warranty: Three states require the auction operator to guarantee the title to all livestock sold. In other states the auction operator must hold the sales proceeds for a specified period if there is any question as to title. If title is not established in the specified period, the operators turn the sales proceeds over to the administrative agency.

Penalties: Most states specify that any person violating any provision of the law or regulations shall be guilty of a misdemeanor and if convicted, shall be subject to fine and/or imprisonment. The penalties provided for vary from $25 or 30 days in prison, or both, to $1,000 or 1 year in prison, or both.

SUMMARY AND CONCLUSIONS

Auctions are the most important single outlet for livestock in Mississippi. Auction operators estimated that over 800,000 head of livestock valued at approximately $20,000,000, were sold through Mississippi auctions in 1943. In addition, 929 farmers reported that they sold over twice as many livestock through auction markets in 1943 as through any other single outlet.

Facilities and services were inadequate at many auctions. In general, large auctions provided better facilities and services than did medium auctions, and medium auctions provided better facilities and services than did small auctions. The small volume of livestock handled at some auctions in certain areas of the State makes it unprofitable for the operators to provide adequate facilities and services. Better facilities and services could be provided if a smaller number of auctions were operating in these areas.

Some of the more important inadequacies of facilities and services at auction markets include: (1) the lack of a high, well-drained location; (2) facilities that are poorly arranged; (3) an insufficient number of pens; (4) sales rings that were too small and poorly lighted; (5) the lack of seating space for buyers and sellers; (6) failure to provide modern scales and to have them tested frequently; (7) failure to clean and disinfect yards frequently and to take or provide other disease-preventive measures; and (8) failure to provide a sufficient number of capable employees with special emphasis on auctioneers, ringmasters, and weighers.

The elimination of certain practices such as (1) by-bidding, (2) misrepresentation of livestock, (3) rough treatment of livestock, and (4) favoritism toward dealers would do much to improve conditions at most auctions.

The majority of auctions in Mississippi make either a single charge of 5 percent commission on gross sales or 5 percent plus 10 cents yardage. Additional charges for insurance and weighing are assessed by a smaller number of auctions.

Selling charges assessed by auctions are higher in Mississippi than in adjoining states and the nation as a whole, and the majority of farmers reporting stated that they would sell more livestock through auctions if those charges were reduced. Consideration should be given to the advisability of assessing charges on a per head basis rather than on a percentage of the gross sale value. Selling charges are higher at auctions than at public terminal markets for most classes of livestock, the only exception being small animals of low value.

Commission and yardage are the principal items of income to auctions. Wages and salaries, truck and auto expense, losses and feed are the most important items of expense. Profits in 1943 averaged $2,877 at three small auctions, $11,860 at two medium auctions, and $21,414 at two large auctions. These figures do not represent what the average operator receives, because half the auctions in the State are operated by partnerships of from two to four partners. However, it must be kept in mind that in most cases, the operation of an auction is a part-time business and that most operators have additional income from one or more sources.

Prices paid at auctions compare rather favorably with those paid at other markets in Mississippi and were higher at large than at small auctions. Prices were highest in the spring when farmers were buying feeder, stocker, and breeder animals, and lowest in the fall when they were selling their surplus livestock. The average good quality livestock sold for as much as two or three times that of the average low quality livestock.

Legislation designed to regulate livestock auction has been enacted in about two-thirds of the states in the nation. Some of the most frequent and important regulations in force in these states are: Operators must be licensed before they can operate; bonds must be carried to insure faithful performance of obligations; records of each transaction must be kept; facilities must be approved before a license is issued; scales must be inspected and tested at regular intervals; floors must be of concrete or other impervious material in all pens used for swine; premises must be cleaned and disinfected after each sale; trucks must be cleaned and disinfected; diseased animals must not be consigned or accepted; livestock must be inspected by an approved veterinarian before they are sold; and swine, except for slaughter, must be vaccinated for cholera.

Following the lead of the majority of states, legislation should be enacted or regulations set up to regulate auctions in the interest of all persons affected by the well being of the livestock industry in Mississippi. This will be necessary because some operators will not go to the expense and trouble of providing adequate facilities and services and of taking precautionary measures against diseases unless they are forced to do so. Some operators hesitate about making these changes because they feel competitors not making similar changes would have all the advantage because of lower overhead and operating expense. If all markets were required to operate on an equal footing, this apparent advantage would disappear. Operators who operate their auctions honestly and efficiently have nothing to fear from supervision but should gain through the elimination of unfair competition and of competitors who provide inadequate facilities and services.

Although there are many instances where the operation of livestock auctions could be improved, they are the most important single outlet for livestock in Mississippi and are performing a much needed service. They offer a ready market for all classes and grades of livestock and have served to educate farmers as to the value of different grades of livestock. Even though auction markets have been operating in Mississippi only a few years, all indications point to their becoming a permanent marketing institution. Auctions with adequate facilities operated by honest efficient management will do much to insure this permanency.

APPENDIX

Table 43. Average prices of livestock by months, 13 auctions, Mississippi, 1943

Items	Best animals	Medium animals	Poorest animals	All animals
Cow and calf (per head)	dollars	dollars	dollars	dollars
January	83.00	65.58	45.77	65.00
February	95.08	73.94	49.96	74.14
March	119.96	79.03	53.75	82.87
April	115.82	85.44	63.35	87.48
May	103.48	70.52	51.26	73.89
June	101.17	70.40	52.59	73.61
July	91.24	64.68	45.98	66.63
August	80.21	63.95	49.12	64.30
September	96.73	69.70	45.89	70.48
October	84.16	62.64	43.33	63.17
November	84.00	51.22	31.27	54.43
December	88.27	61.52	36.68	61.97
Year	96.92	69.24	48.65	70.98
Cows (per head)				
January	78.26	52.60	35.13	54.63
February	88.85	65.66	40.39	65.15
March	95.29	66.51	45.31	68.41
April	109.06	71.98	54.76	77.00
May	89.30	65.99	46.18	66.85
June	89.22	61.57	40.48	63.17
July	82.28	54.49	34.41	56.38
August	76.60	52.14	32.86	53.42
September	81.68	50.66	35.13	54.49
October	77.83	47.61	31.99	51.26
November	71.79	44.50	28.11	47.22
December	72.78	53.51	33.48	53.33
Year	87.16	59.46	40.11	61.52
Heifers (per head)				
January	44.16	27.56	18.26	29.38
February	49.81	32.79	19.69	33.77
March	54.38	34.91	23.26	36.83
April	61.01	40.85	24.69	41.84
May	57.50	39.27	27.00	40.75
June	54.22	39.97	25.47	39.91
July	46.89	33.58	19.50	33.39
August	44.78	31.66	16.82	31.23
September	39.34	26.20	16.56	27.05
October	41.36	26.13	14.89	27.10
November	40.33	23.57	14.84	25.56
December	34.55	22.73	14.24	23.54
Year	49.28	33.26	20.76	34.14

Table 43. Average prices of livestock by months, 13 auctions, Mississippi, 1943—Continued

Items	Best animals	Medium animals	Poorest animals	All animals
Cows (per cwt.)	dollars	dollars	dollars	dollars
January	10.09	8.23	6.33	8.22
February	9.82	9.33	7.18	8.92
March	11.65	9.51	6.64	9.33
April	12.91	10.90	8.30	10.75
May	12.03	10.24	8.03	10.14
June	10.85	8.23	6.02	8.33
July	10.30	8.21	6.10	8.20
August	9.32	7.23	5.31	7.27
September	9.76	7.66	5.39	7.62
October	8.35	6.59	5.10	6.66
November	8.25	5.09	4.66	5.77
December	9.31	7.16	5.16	7.20
Year	9.58	7.42	5.68	7.52
Heifers (per cwt.)				
January	11.83	10.26	8.88	10.31
February	13.14	10.68	9.33	10.96
March	(1)	(1)	(1)	13.56
April	15.49	12.34	10.39	12.58
May	(1)	(1)	(1)	12.18
June	13.33	11.98	10.00	11.84
July	12.63	10.84	9.14	10.87
August	11.57	9.95	7.99	9.87
September	10.83	9.22	7.17	9.12
October	9.75	8.36	6.79	8.32
November	9.36	8.02	6.54	7.98
December	10.74	8.96	7.32	8.99
Year	11.61	10.03	8.18	9.96
Bulls (per cwt.)				
January	11.83	10.04	8.42	10.08
February	11.81	10.20	9.08	10.32
March	13.17	11.76	10.20	11.73
April	13.32	11.72	9.91	11.67
May	12.58	10.28	9.25	10.59
June	11.31	9.81	8.41	9.84
July	11.05	9.15	8.24	9.40
August	9.68	8.69	7.90	8.74
September	10.23	8.30	7.30	8.54
October	9.81	7.79	6.66	8.01
November	8.93	7.17	5.86	7.28
December	9.02	7.67	6.74	7.77
Year	11.22	8.90	7.92	9.23

Table 43. Average prices of livestock by months, 13 auctions, Mississippi, 1943—Continued

Items	Best animals	Medium animals	Poorest animals	All animals
Steers (per cwt.)	dollars	dollars	dollars	dollars
January	12.38	11.15	9.34	11.01
February	13.35	11.96	10.06	11.84
March	14.83	13.67	11.41	13.42
April	15.66	14.10	12.17	14.05
May	(1)	(1)	(1)	12.02
June	13.42	11.68	8.63	11.38
July	12.50	10.85	9.53	10.93
August	11.29	9.57	8.25	9.67
September	12.05	9.29	7.89	9.61
October	10.38	8.34	7.40	8.60
November	9.97	8.32	6.58	8.30
December	10.53	8.99	7.19	8.93
Year	12.24	10.30	8.71	10.38
All calves (per cwt.)				
January	12.11	9.95	8.01	10.01
February	13.06	11.05	8.86	11.00
March	14.14	11.74	9.55	11.79
April	15.22	12.91	10.70	12.94
May	13.60	11.38	9.37	11.43
June	12.75	10.23	8.26	10.37
July	11.69	9.14	7.98	9.48
August	11.82	9.15	7.37	9.37
September	11.83	9.23	6.90	9.30
October	10.90	8.22	6.28	8.41
November	10.07	7.28	5.50	7.53
December	11.13	7.59	6.67	8.24
Year	12.10	9.53	7.59	9.69
Heifer calves (per cwt.)				
January	12.86	10.85	8.98	10.88
February	13.50	11.94	9.82	11.80
March	14.86	13.17	11.13	13.08
April	16.08	14.10	11.88	14.04
May	15.08	13.14	11.14	13.13
June	13.81	12.00	10.22	12.01
July	12.74	10.85	9.38	10.96
August	12.62	9.47	7.62	9.79
September	12.35	9.40	7.48	9.66
October	10.98	8.34	6.67	8.58
November	10.48	7.94	6.27	8.15
December	11.02	8.94	6.94	8.96
Year	12.90	10.63	8.73	10.72

Table 43. Average prices of livestock by months, 13 auctions, Mississippi, 1943—Continued

Items	Best animals	Medium animals	Poorest animals	All animals
Bull calves (per cwt.)	dollars	dollars	dollars	dollars
January	11.07	8.55	7.34	8.88
February	11.48	9.24	8.04	9.50
March	13.48	10.65	8.21	10.74
April	14.01	11.57	10.05	11.80
May	12.27	9.99	8.87	10.28
June	11.34	8.69	7.44	9.04
July	10.49	7.83	8.03	8.52
August	10.40	8.15	7.22	8.48
September	10.26	7.48	6.47	7.92
October	9.42	6.85	5.72	7.25
November	8.55	5.92	4.98	6.34
December	9.20	6.89	5.55	7.13
Year	10.69	8.19	7.11	8.54
Steer calves (per cwt.)				
January	12.49	10.80	8.56	10.67
February	14.07	11.78	8.51	11.54
March	14.72	12.35	10.26	12.41
April	15.70	13.58	11.11	13.49
May	14.67	12.95	9.92	12.63
June	13.83	12.08	8.97	11.75
July	13.05	10.25	8.07	10.40
August	11.87	9.54	7.67	9.65
September	12.19	8.82	7.01	9.20
October	11.76	8.68	6.22	8.83
November	10.59	8.40	5.95	8.34
December	9.58	7.58	6.03	7.69
Year	12.84	10.49	8.16	10.49
All hogs (per cwt.)				
January	13.52	12.61	10.92	12.42
February	14.05	13.07	11.48	12.92
March	14.10	13.12	11.31	12.91
April	13.65	12.83	11.26	12.64
May	13.56	12.78	10.89	12.50
June	13.36	12.04	10.12	11.89
July	13.03	12.20	9.85	11.83
August	13.37	12.49	9.38	11.95
September	13.55	12.27	9.05	11.80
October	13.49	12.39	10.34	12.16
November	12.19	10.52	8.07	10.33
December	11.28	9.44	7.24	9.35
Year	13.27	12.25	10.13	11.98

Table 43. Average prices of livestock by months, 13 auctions, Mississippi, 1943—Continued

Items	Best animals	Medium animals	Poorest animals	All animals
Hogs (240 & above) (per cwt.)	dollars	dollars	dollars	dollars
January	13.69	12.90	11.52	12.75
February	14.30	13.55	11.82	13.31
March	14.24	13.43	11.11	13.05
April	13.98	13.18	11.38	12.94
May	13.63	12.95	11.10	12.66
June	13.11	12.26	9.33	11.77
July	12.83	12.01	8.67	11.39
August	13.49	12.41	9.68	12.01
September	13.93	12.66	9.11	12.12
October	13.83	12.92	10.34	12.51
November	12.72	11.45	8.91	11.13
December	12.19	10.50	8.29	10.37
Year	13.52	12.54	10.26	12.22
Hogs (180-240) (per cwt.)				
January	13.90	13.15	11.56	12.95
February	14.21	13.43	12.00	13.27
March	14.55	13.70	12.19	13.54
April	14.12	13.36	11.98	13.21
May	13.73	13.18	11.62	12.92
June	14.99	11.49	11.02	12.25
July	13.22	12.50	10.10	12.10
August	13.70	13.21	9.02	12.34
September	14.18	13.03	10.61	12.72
October	13.96	13.16	11.38	12.91
November	12.74	11.84	9.55	11.50
December	12.03	10.47	7.80	10.19
Year	13.79	12.77	10.88	12.55
Hogs (80-180) (per cwt.)				
January	13.21	12.14	10.19	11.92
February	13.85	12.64	11.06	12.55
March	13.77	12.63	10.89	12.50
April	13.30	12.44	10.92	12.77
May	13.44	12.52	10.44	12.23
June	12.92	12.14	10.66	11.82
July	13.02	12.10	10.32	11.89
August	13.09	12.06	9.42	11.67
September	12.90	11.47	8.03	10.97
October	13.01	11.61	9.66	11.48
November	11.51	9.16	6.72	9.14
December	9.83	7.61	5.85	7.73
Year	12.87	11.81	9.68	11.55

Table 43. Average prices of livestock by months, 13 auctions, Mississippi, 1943—Continued

Items	Best animals	Medium animals	Poorest animals	All animals
Sheep (per cwt.)	dollars	dollars	dollars	dollars
January	(1)	(1)	(1)	11.80
February	(2)	(2)	(2)	(2)
March	(2)	(2)	(2)	(2)
April	(2)	(2)	(2)	(2)
May	(2)	(2)	(2)	(2)
June	(2)	(2)	(2)	(2)
July	11.26	8.46	4.84	8.26
August	11.59	9.49	4.21	8.68
September	(2)	(2)	(2)	(2)
October	9.50	8.42	7.05	8.35
November	(2)	(2)	(2)	(2)
December	(2)	(2)	(2)	(2)
Year	11.10	8.97	5.36	8.60
Sheep (per head)				
January	(1)	(1)	(1)	5.00
February	(2)	(2)	(2)	(2)
March	8.38	8.00	6.25	7.66
April	6.00	6.00	5.86	5.98
May	(2)	(2)	(2)	(2)
June	(1)	(1)	(1)	5.38
July	(1)	(1)	(1)	5.00
August	8.00	5.47	3.83	5.68
September	(1)	(1)	(1)	3.22
October	(1)	(1)	(1)	4.71
November	4.95	4.10	3.96	4.27
December	(2)	(2)	(2)	(2)
Year	6.47	5.70	4.95	5.70
Goats (per head)				
January	(1)	(1)	(1)	2.27
February	3.18	1.55	1.54	1.96
March	(1)	(1)	(1)	1.57
April	2.94	2.48	2.20	2.53
May	5.37	2.44	1.95	3.03
June	6.39	2.90	2.28	3.60
July	3.74	2.73	2.41	2.90
August	3.58	2.72	2.06	2.77
September	4.29	1.93	1.81	2.47
October	4.62	3.43	2.23	3.43
November	3.24	2.29	2.00	2.46
December	2.75	2.19	1.52	2.17
Year	3.68	2.37	1.91	2.58

Table 43. Average prices of livestock by months, 13 auctions, Mississippi, 1943—Continued

Items	Best animals	Medium animals	Poorest animals	All animals
Mules (per head)	dollars	dollars	dollars	dollars
January	114.66	64.25	13.89	64.41
February	104.46	42.97	5.28	48.74
March	135.30	68.42	24.52	74.16
April	93.23	51.56	16.58	53.23
May	(1)	(1)	(1)	57.00
June	(1)	(1)	(1)	15.57
July	(1)	(1)	(1)	30.35
August	(1)	(1)	(1)	85.44
September	136.73	80.37	11.73	77.30
October	157.50	93.83	13.96	89.78
November	146.59	46.93	1.34	60.45
December	151.94	40.25	1.78	58.55
Year	128.43	60.02	12.38	65.11
Horses (per head)				
January	(1)	(1)	(1)	51.34
February	120.00	57.69	21.30	63.33
March	(1)	(1)	(1)	57.23
April	105.00	53.54	23.80	58.48
May	(1)	(1)	(1)	74.69
June	(1)	(1)	(1)	67.75
July	(1)	(1)	(1)	68.13
August	(1)	(1)	(1)	35.00
September	(1)	(1)	(1)	37.75
October	(1)	(1)	(1)	36.86
November	(1)	(1)	(1)	58.73
December	(1)	(1)	(1)	54.10
Year	99.71	51.86	22.87	56.04
Mares (per head)				
January	(1)	(1)	(1)	60.40
February	92.71	51.67	17.29	53.28
March	92.50	67.46	29.58	64.25
April	114.11	60.76	29.28	65.87
May	(1)	(1)	(1)	55.15
June	(1)	(1)	(1)	59.09
July	(1)	(1)	(1)	52.95
August	(1)	(1)	(1)	63.50
September	(1)	(1)	(1)	91.12
October	103.21	70.38	22.93	67.08
November	101.11	69.67	21.94	65.82
December	(1)	(1)	(1)	47.92
Year	103.46	59.75	24.69	61.72

Table 43. (Continued). Average prices of livestock by months, 13 auctions, Mississippi—1943.

Items	Best animals	Medium animals	Poorest animals	All animals
Colts	dollars	dollars	dollars	dollars
(per head)				
January	(1)	(1)	(1)	37.50
February	(1)	(1)	(1)	51.29
March	(1)	(1)	(1)	35.40
April	(1)	(1)	(1)	35.64
May	(2)	(2)	(2)	(2)
June	(1)	(1)	(1)	45.63
July	(1)	(1)	(1)	28.00
August	(2)	(2)	(2)	(2)
September	(1)	(1)	(1)	44.75
October	(1)	(1)	(1)	34.40
November	(1)	(1)	(1)	35.13
December	(2)	(2)	(2)	(2)
Year	60.28	36.88	23.00	38.76

Source: Records of 13 auction companies.

[1] Where less than 20 sales were recorded, the averages for the best, medium and low quality animals were not given for that month.

[2] No sales recorded.

Note: Heifers, bulls and steers weighing over 500 pounds were classified as mature animals, whereas those weighing under 500 pounds were classified as calves.

BULLETIN 401 JUNE 1944

Milk Production

Compiled by H. O. WEST, Research Coordinator

Jointly Representing Mississippi State Vocational Board
and : : Mississippi Agricultural Experiment Station

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

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Milk Production

By H. O. WEST*

The production of milk has expanded greatly in Mississippi during the last few years. There are several sections of the State that seem to have very good possibilities as milk producing centers. Many agricultural leaders have been stressing the importance of a diversified system of farming for Mississippi agriculture. Under a diversified system of farming, milk production on a commercial scale will naturally find a place, especially with cotton acreage reduced as it has been for the last 10 years.

According to milk production statistics, the first efforts toward the development of milk production on a commercial scale in Mississippi were initiated in 1909. At that time statistics show the average production per cow in Mississippi was 1500 pounds of milk. Much progress has been made in milk production since that date. The average production per cow at the present time is 2700 pounds, which no doubt means that the average production of many commercial producing herds is considerably above this figure. This does not mean, however, that there is no room for further improvement in the milk production industry.

The success or failure of a milk producing program on a given farm depends almost wholly on economical production of milk. In this connection it should be pointed out that high production per cow does not always mean the most economical production, and to determine the profitableness of a milk production business requires careful checking of individual cows of the herd. This can best be done by keeping records which show the production and feed consumption for individual cows.

Economical production depends on a number of factors which are quite important, and such factors should receive careful consideration by present as well as prospective milk producers. Some of these factors are: (1) feeding, (2) production of replacement stock, and (3) disease and parasite control. No doubt there are many other factors having a direct bearing on the success of a milk-producing business but it is believed that those mentioned above are the ones that have more common application under Mississippi conditions. An attempt is made in this publication to present information on these factors that should be helpful to Mississippi producers in selecting and putting into effect those practices which should result in more profitable milk production enterprises.

FEEDING FOR MILK PRODUCTION

There are a number of important factors that should be considered in connection with the production of milk but so far as Mississippi farmers are concerned it seems that one of the more important considerations is that of feeding. Dairy cattle may be classified as machines that convert feed into milk. It is generally recognized that of all the domestic animals, dairy cows are among the more efficient converters of feed into food products. As an example, the dairy cow producing annually 8,000 pounds of milk of average quality, produces 272 pounds of protein, 296 pounds of fat, 392 pounds of milk sugar, and 56 pounds of mineral matter. . This is 56 percent more protein, 30 percent more non-nitrogenous nutrients, and 19 percent more mineral matter than is contained in the entire body of a fat 2-year-old steer weighing 1200 pounds. From these figures it can be seen that the dairy cow must receive an ample supply of feed if she is to produce milk efficiently.

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*Jointly representing Mississippi Agricultural Experiment Station and Mississippi State Vocational Board.

A considerable amount of experimental work has been done to determine the total amount of different feed nutrients needed by the dairy cow with a given production. According to authorities a 1000-pound dairy cow producing 25 pounds of milk daily should receive daily approximately 2.4 pounds of protein and 17.5 pounds of total digestible nutrients. It is generally recognized that the dairy cow should receive a ration with a much narrower nutritive ratio than other classes of livestock. It seems to be important that some consideration be given to the actual feed requirements of dairy cattle in planning a system to use. It should be pointed out, however, that the standards or exact requirements should not be the main consideration in planning the feeding system to use. Considerable experimental work has been done in connection with feeding dairy cattle and it is felt that as a result of this experimentation some conclusions can be reached as to the best method to use in feeding for milk production. It is doubtful, however, that the results of the experiment will show conclusively the best feeds or combinations of feeds to use in a feeding program. It is important, therefore, that careful planning be done in setting up a feeding system, giving consideration to feeds available on the farm as well as to those feeds that can be purchased without difficulty in a given locality.

Feeding of dairy cattle is important because the success or failure of the enterprise depends largely on the cost of feeding in relation to the income from products sold. In planning the feeding system consideration should be given to the use of those feeds that can be economically produced on the farm. Often times by following this practice a scarcity of feed is avoided. Important, also, is the fact that this system provides for a fuller year-round utilization of labor required to handle the milk-producing enterprise.

To help with the planning of a feeding system to use, information is presented in this section dealing with the feeding of concentrates, including protein feeds such as cottonseed meal, peanut meal, linseed meal, and others; and grain or carbohydrate feeds such as corn, rye, barley, and others. Information is also presented on roughages which include hay, silage, and pasture, and on the value of minerals in a feeding program. A careful study of this information should be helpful in working out a feeding system to use on Mississippi farms.

Protein Feeds

It is generally recognized by authorities on dairy feeding that dairy cows will not produce a maximum amount of milk unless protein is supplied in sufficient quantities.

Another reason for the importance of protein feeds is that some of these feeds are more expensive than other feeds in a dairy cow's ration. Therefore, careful consideration should be given to the selection and use of protein feed sources that are readily available, efficient, and as inexpensive as possible to obtain.

In selecting a source of protein for the dairy cow it is important to consider using those that are produced or may be produced on the farm. So far as Mississippi farmers are concerned cottonseed meal is usually available in sufficient quantities to take care of the need. Soybean meal is also produced in Mississippi.

A careful study should be made of experimental tests that have made use of different protein feeds to determine the amounts that can be fed most profitably and without injurious effect.

Cottonseed meal is a good source of cheap protein for dairy cattle but is deficient in carotene, the precursor of vitamin A, and wherever fed in large quantities or over an extended period of time it is necessary to supply the cow or calf with either green grazing or good quality green hay that has not been stored too long in order to safeguard the health of the animal against vitamin A deficiencies.

According to authorities on dairy cattle feeding, a 1000-pound dairy cow should receive 0.7 pounds of protein daily for body maintenance, and an additional amount for the milk that is produced. For example, a 1000-pound dairy cow producing 25 pounds of 5 percent milk, which is approximately 3 gallons, should receive approximately 2.4 pounds of protein daily. Not all of this amount of protein has to be supplied from feeds having a high protein content, for most feeds contain at least a small percentage of protein. Yet, in order to get the right relationship between the protein and total digestible nutrients in the dairy ration, it is essential that much of the protein be supplied from feeds containing a relatively high percentage of protein.

The results of a number of experiments using different sources of protein are shown below, and should be considered carefully in planning for the feeding of dairy cows.

A Comparison of Ground Soybeans and Cottonseed Meal and Soybean Meal for Feeding Dairy Cows in Mississippi, 1923

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 21 days in November 1923.

Purpose: Test 1. To compare cottonseed meal and soybean meal for feeding dairy cows.

Test 2. To determine the relative value of soybean meal and ground soybeans in milk production.

Procedure and conditions: Test 1. Soybean meal versus cottonseed meal. The grain mixture consists of 50 percent corn chops, 16-2/3 percent wheat bran, and during the first and third period 33-1/3 percent cottonseed meal; while during the second period the cottonseed meal was replaced with 33-1/3 percent ground soybeans, the Mammoth yellow variety being used. In addition, corn silage and alfalfa hay were used as roughages.

Four Jerseys and one Ayrshire were used in the test. Two cows freshened in June, two in September, and one in October.

Test 2. Ground soybeans versus soybean meal. This test was made under the same conditions as test 1. Five cows were used and the same basal rations were given except that soybean meal was used in the grain mixture during period 2 in place of ground soybeans. Thus, the grain mixture was as follows: 50 percent corn chops, 16-2/3 percent wheat bran and in periods 1 and 3, 33-1/3 percent soybean meal and in period 2, 33-1/3 percent ground soybeans. Four cows were used in this test. One freshened in August, two in September, and one in October.

Table 1. Ground soybeans and cottonseed meal and soybean meal for feeding dairy cows in Mississippi, 1923

	Cottonseed meal versus soybean meal		Ground soybeans versus soybean meal	
	Period 2	Period 1 & 3	Period 2	Period 1 & 3
Production of milk	353.8	381.4	415.8	411.0
Percentage fat	4.05	3.90	4.17	3.85
Pounds fat	14.32	14.89	17.32	15.84
Gain or loss in liveweight, lbs.	13.4	1.6	5.0	—13.0
Feed per 100 pounds milk:				
Hay, lbs.	49.74	46.14	45.69	10.96
Silage, lbs.	152.61	141.53	132.28	33.19
Mixed grain, lbs.	22.61	20.97	22.12	5.31
Test grain, lbs.	11.30	10.48	11.48	2.65

Reference: Mississippi Agricultural Experiment Station Bulletin 235, "Soybeans for Dairy Cows," pages 11, 12, 13, and 14, tables 22, 23, 24, 25, 26, and 27, State College, Mississippi, June 1926.

Feeding Cottonseed Meal and Soybean Oil to Dairy Cows in Louisiana

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: 3-year average, 1932-34.

Purpose: To compare the feeding value of cottonseed meal and soybean meal for dairy cows.

Procedure and conditions: Two groups of six purebred Holstein heifer calves each were started on this phase in November 1929. Group 1 received an experimental ration composed of 25 parts soybean oil meal, 75 parts yellow corn, 2 parts oystershell flour, 1 part common salt, and corn and soybean silage in winter. Group 2 received the same ration except that cottonseed meal replaced the soybean oil meal. All other conditions were kept as nearly alike as possible. The heifers were fed according to weight by the Morrison standard except in summer, when silage was replaced by pasture and an average of 4 pounds of grain was fed daily.

After freshening, the respective grain rations were gradually increased at the rate of 1 pound grain to each 3 pounds of milk produced. Milk production reached 40 pounds daily in all cases, and nearly 60 pounds daily with five heifers. Thus, consumption of grain was 18 pounds daily in some cases, with an average of over 16 pounds daily for the first 6 months of lactation. As one-fourth of the grain mixture was either cottonseed meal or soybean oil meal, the heifers consumed 4 pounds daily of these high protein feeds for 6 to 10 months with no ill effects, except in one case. A heifer receiving 18 pounds of soybean oil meal per day developed an inflamed vulva at one period of estrum. A local veterinarian pronounced it typical protein poisoning, but marked feed reduction overcame the condition in a few days. Silage was fed at the rate of 6 pounds per 100 pounds liveweight during the winter. Sixty pounds daily were consumed by the larger heifers in cool weather. Heifers were milked and fed three times daily with the regular herd.

All heifers were re-bred to freshen within 12 to 13 months, with the exception of one, which became a non-breeder because of difficult calving. This heifer, receiving cottonseed meal ration, was eliminated from the experiment. Normal heifers had a gestation period of 279 days on the soybean oil meal ration and 282 days on the cottonseed meal ration. At the end of 10 months lactation, the remaining heifers were dried off and the ones in group 1 given the cottonseed meal ration, while the others in group 2 were given the soybean oil meal ration. About 4 pounds daily were fed for 40 days prior to calving, and after freshening, the same rate of feeding was followed with the reversed rations as in the first lactation. Silage consumption was greater during this lactation, reaching 70 pounds for the larger heifers. At the end of 10 months lactation, these heifers were dried off and the remaining five normal heifers carried through a third lactation on a herd ration, hay, and limited silage. One of the original eight experimental heifers developed a foot infection and was sold, while one on each of the two rations was not bred in time to calve with the other five heifers. These three are eliminated for third lactations.

Check group which is designated as "herd ration plus hay" and consists of three Holstein heifers of slightly older age, which were fed a ration of 40 parts corn or hominy, 20 parts each of oats, wheat bran, and cottonseed meal, and 1 part salt throughout three normal lactations which covered the same peroid of time as the experimental groups. This herd ration was fed at the same rate per pound of milk as to the experimental heifers. Mixed legume and grass hay and silage were supplied according to appetite. These heifers were fed less grain prior to calving, but were of approximately the same size as the experimental heifers. They were handled in the same manner and pastured with the experimental group, the only apparent difference in type of grain mixture fed and the replacement of one-half the silage by hay in winter. The third lactation of the experimental heifers was made under these conditions, as was mentioned earlier.

Table 2. Average pounds of 4 percent fat corrected milk in 305 day lactations in Louisiana, 1932-34

	First lactation	Second lactation	Av. first and second lactation	Third lactation herd ration and hay*	Difference between 3rd and av. of 1st & 2nd
Soybean oil meal, no hay	10,855.1	11,190.3	11,022.7		
Cottonseed meal, no hay	10,750.2	11,043.9	10,897.0		
Average both rations for heifers with 3 lactations	10,738.8	11,730.4	11,234.6	8,996.8	—2,237.8
Herd ration plus hay	8,686.2	9,352.6	9,019.4	8,612.7	—406.7
Difference in favor of experimental rations	2,052.6	2,377.8	2,215.2	384.1	1,831.1
Net difference (less 384.1)	1,666.3	1,993.7	1,831.1		
Percent net increase over herd ration and hay	19.18	21.32	20.30	4.46	

*40 parts corn, 20 parts each of oats, wheat bran, cottonseed meal, and hay.

Reference: Louisiana Agricultural Experiment Station Bulletin 278, "Cottonseed Meal Ration and Silage versus Herd Ration, Hay, and Silage," pages 2, 3, 4, 5, and 6, table 1, Baton Rouge, Louisiana, October 1936.

Cottonseed versus Cottonseed Meal for Milk Production

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: October 8, 1931 to February 8, 1932.

Purpose: To compare the feeding of cottonseed meal and cottonseed to dairy cows.

Procedure and conditions: The first experiment was planned to supplement a ration of corn, oats, and bran with one-fifth cottonseed meal or one-third cottonseed. Thus, 2 pounds of seed were fed for 1 of meal. The seed was obtained from a local gin and the cottonseed meal was purchased locally as choice or 8 percent nitrogen meal. A limited amount of soybean hay, silage, and pasture was available. Grain was fed heavily to obtain the maximum effect of cottonseed products.

Two groups of four Holstein cows each were used in a 3-month trial. One group received the meal, while the other was fed whole cottonseed with the rations being reversed each 30 days. Five days were used for a gradual change in feed and the 25-day periods were used in computing the results. Thus changing conditions, decline in milk, and other factors were equalized. Liveweights were obtained for 2 consecutive days, a 1-day milk test made and cream samples saved each month.

During the entire trial no laxative condition developed, even though one cow received 7 pounds seed and all cows averaged 5.8 pounds seed daily. In three cases seed was refused when heavily fed. At other times the seed was eaten readily. In spite of this, the cows gained more in weight and produced 5.7 percent more milk while on meal than on seed. The results of the test are shown in table 3.

Table 3. Cottonseed versus cottonseed meal for milk production in Louisiana, Otcober 1931 to January 8, 1932

	Cottonseed average of group	Cottonseed meal average of 3 groups
Number of cows	4	4
Average liveweight	1,045	1,057
Production:		
Milk	9,980	10,377
Percent fat	3.54	3.48
Pounds fat	354.00	361.00
Feed consumed:		
Grain	5,288	4,611
Hay	1,361	1,332
Silage	6,512	6,728

Reference: Louisiana Agricultural Experiment Station Bulletin 227, "Cottonseed for Dairy Cows," pages 3 and 4, table 1, Baton Rouge, Louisiana, July 1932.

Cottonseed Meal As the Principal Source of Protein for Dairy Animals

Conducted by: New Mexico Agricultural Experiment Station.

Conducted at: State College, New Mexico.

Period: 1934.

Purpose: To determine if cottonseed meal could be used successfully as the principal source of protein when fed with certain roughages common to New Mexico. The roughages chosen for this experiment were alfalfa hay, cane hay, and corn silage.

Procedure and conditions: When the experiment was initiated, 20 Holstein heifer calves from high grade dams were secured when from 1 to 12 days old. All of the calves were strong and healthy at birth, although some of them were considerably under average weight.

The calves were divided into four groups of five each. In an effort to select for the different lots calves that would be as nearly equal in inheritance as possible, four calves each of five registered Holstein bulls whose pedigrees had similar indications of production were secured, and one calf from each bull was placed in each of the four lots. The calves sired by the first bull were numbered C1, C2, C3, and C4, in the order in which they were obtained. They were then placed in groups 1, 2, 3, and 4, in numerical order. This system of numbering and of assigning to groups was followed for the daughters of each of the other four bulls, so that the second animal listed in each group was sired by the second bull, the third in each group by the third bull, the fourth by the fourth bull, and the fifth by the fifth bull.

All heifers were fed in the regular dairy barn in individual mangers. Except while being fed they were allowed the run of a large vegetation-free corral, and had free access to salt and water while in the corrals.

The rations for the four groups were as follows:

Group 1: (the check group)
    Whole milk until 75 days of age
    Alfalfa hay
    Corn silage
    A grain mixture of 3 parts ground No. 2 mixed corn, 1 part wheat bran, and 1 part linseed meal

Group 2:
    Whole milk until 75 days of age
    Alfalfa hay
    Corn silage
    Cottonseed meal (43 percent)
    Ground No. 2 mixed corn

Group 3:
    Whole milk until 2 weeks of age
    Skim milk until 5 months old
    Cane hay
    Corn silage
    Cottonseed meal
    Ground No. 2 mixed corn

Group 4:
    Whole milk until 2 weeks of age
    Skim milk until 5 months old
    Cottonseed meal
    Ground No. 2 mixed corn
    Cane hay

The same roughages and concentrates that had been used during the growing period were continued after the heifers in each group had freshened. In groups 1 and 2 the silage was increased to about 24 pounds a day and the alfalfa to about 12 pounds. As nearly as possible, the heifers in group 3 were fed cane hay and corn silage at the rate of 1 pound of each for each 100 pounds of liveweight. Again an attempt was made but in this instance, also, unsuccessfully, to get the heifers in group 4 to eat enough cane hay to furnish the same amount of dry matter as those in group 3 received in cane hay and corn silage.

Table 4. Cottonseed meal as the principal source of protein for dairy animals, New Mexico, 1934

	Group 1	Group 2	Group 3	Group 4
	Pounds	Pounds	Pounds	Pounds
Feed consumed from birth to close of 15th month				
Whole milk	661.2	603.5	325.0	
Skim milk			1,605.0	1,404.7
Grain	1,400.1			
Corn		463.8	456.5	395.8
Cottonseed meal		700.0	700.7	638.0
Alfalfa	2,214.0	2,027.1		
Cane hay			1,921.3	1,575.0
Silage	1,999.1	1,856.4	1,733.0	
First lactation period and second gestation period				
Grain	4,023.6			
Corn		2,428.2	2,646.9	1,971.4
Cottonseed meal		1,589.7	2,686.5	2,135.0
Alfalfa	5,802.8	4,741.3		
Cane hay			4,347.7	5,907.5
Silage	11,536.6	9,610.5	10,247.7	
Milk produced	9,125.52	9,524.87	10,329.55	7,411.86
Butterfat produced	308.33	330.59	375.25	271.11
Butterfat, percent	3.378	3.471	3.632	3.657
Second lactation period and third gestation period				
Grain	3,436.7			
Corn		2,348.2	2,355.7	2,394.8
Cottonseed meal		1,265.2	4,306.8	2,578.3
Alfalfa	5,380.5	4,542.2	2,357.3	
Cane hay			4,306.8	7,833.3
Silage	10,545.8	9,112.3	10,247.7	
Milk produced	8,317.03	9,669.52	10,334.5	10,954.3
Butterfat produced	276.38	351.82	373.02	373.13
Butterfat, percent	3.323	3.638	3.609	3.406

Reference: New Mexico Agricultural Experiment Station Bulletin 226, "Cottonseed Meal as the Principal Source of Protein for Dairy Animals," pages 3, 4, 6, 7, 8, 10, 24, 25, 39, 40, and 41; tables 5 and 9, State College, New Mexico, September 1934.

Feeding Cottonseed Meal to Dairy Cows

Conducted by: Oklahoma Agricultural Experiment Station.

Conducted at: Stillwater, Oklahoma.

Period: 1927-1931.

Purpose: To study the effects of cottonseed meal on dairy cows during reproduction and production periods.

Procedure and conditions: The Oklahoma Agricultural Experiment Station began feeding cottonseed meal containing 43 percent total crude protein to dairy calves when 30 days old, continuing through the growing period and until they had completed one lactation period. Records are available on four cows that have been fed on cottonseed meal from 30 days of age through the second lactation period. The results of these records are shown in table 5.

The allowance of cottonseed meal was usually reduced a few days after calving and then gradually increased until each animal received all the meal she would consume. In most cases maximum consumption was reached during the second month of lactation and then continued with little change for periods ranging from 4 to 8 months. On the average 10.8 pounds of cottonseed meal and 13.3 pounds of prairie hay were consumed daily by each of the 12 animals which have completed one lactation period.

In order to put cottonseed meal to a very crucial test and one in which the effects of cottonseed meal feeding would not be clouded by the beneficial influences of either a good grain mixture or a good roughage or succulent feeds such as silage or pasture the animals have at all times been kept in a dry lot and always supplied a basal ration of cottonseed meal, prairie hay, salt and water. Calves were fed milk only during the first 6 months.

By "4 percent fat corrected milk" is meant the amount of 4 percent milk equivalent to the amount of milk actually produced.

Table 5. Milk production of cows grown on cottonseed meal rations at Stillwater, Oklahoma, 1927-31

Number of animals	Days in milk	Milk pounds	Fat pounds	4 percent corrected milk
			First lactation	
Av. 12 cows	314	5,086.1	261.28	5,953.61
			Second lactation	
1	266	3,171.5	154.28	3,584.30
2	305	4,144.6	192.28	4,542.04
3	322	4,996.8	287.41	6,309.87
4	309	6,513.8	387.29	8,414.87
Av. 4 cows	301	4,706.7	255.34	5,712.78
Same cows first lactation	285	4,364.1	229.50	5,188.13

The history of animal No. 5, one of the oldest animals in the experiment, includes some very interesting records. Some of these are shown in table 6.

Cow No. 5 grade Jersey was born May 30, 1927, and her average weight during the last 12 months of the test was 831 pounds. During her life time she has already consumed more than 8 tons of cottonseed meal; has conceived to the first service three different times and has dropped three living calves, all of which were raised. In her third lactation she reached a maximum daily consumption of 21 pounds of cottonseed meal and for 35 consecutive days consumed an average of 20 pounds of meal daily. She has been fed cottonseed meal and prairie hay since she reached the age of 30 days. After being weaned from milk at the age of 6 months, cottonseed meal, prairie hay, salt, and water have constituted her entire ration. In her first three lactation periods she has produced 316, 387, and 417 pounds of butterfat, respectively, in 310, 309, and 311 days, or a total of 1,120 pounds of butterfat in 930 days.

Table 6. Feed consumption, cow No. 5, Stillwater, Oklahoma, 1927-31

		Total feed consumed		Av. daily feed consumed	
	No. days	Cottonseed meal, lbs.	Prairie hay, lbs.	Cottonseed meal, lbs.	Prairie hay, lbs.
First gestation	261	1,824.9	2,551.5	7.0	9.8
First lactation	310	3,930.9	4,398.4	12.7	14.2
First dry period	78	566.0	942.0	7.1	12.1
Second lactation	309	4,637.5	3,864.8	15.0	13.5
Second dry period	68	805.5	886.6	11.8	13.0
Third lactation (to date)	150	2,534.8	2,072.1	16.9	13.8
Total	1,176	14,299.6	14,710.4	12.2	12.5

Cottonseed Meal for Dairy Cows

In starting this investigation on cottonseed meal feeding, calves were included in the trials, these calves on maturing being used in the milk production trials. Twenty-eight grade Jersey calves have been raised to the age of 6 months during the 5 years on milk and a basal ration of cottonseed meal and prairie hay. Only 4 calves started in the earlier groups have died but in no case did cottonseed meal seem to be the cause of the deaths.

The calves used were fed whole milk the first 6 weeks and skim milk until they were 6 months old. When they were several weeks old and showed a desire for other feeds they were offered cottonseed meal and prairie hay. The amount of cottonseed meal offered the first two groups in which 11 calves were raised was limited to one-half pound of meal daily for each 100 pounds liveweight until they were 6 months old. After that age 1 pound of meal daily for each 100 pounds liveweight was allowed. Since this ration did not enable the calves to make normal growth later groups were fed as much cottonseed meal and prairie hay as they desired. Seventeen calves raised in this manner developed satisfactorily. The average daily consumption of cottonseed meal per calf for these 17 animals was 1.1 pounds, 2.8 pounds, 5.0 pounds, and 6.0 pounds during the third, sixth, ninth, and twelfth month, respectively. This is considerably more than was consumed by the first 11 head during the same months.

Reference: Oklahoma Agricultural Experiment Station 1926-30 and 1930-32 Reports, pages 152, 153, 154, 155, 156, and 157, 1930-32 Reports, Stillwater, Oklahoma.

Peanut, Velvet Bean, and Cottonseed Meal for Milk Production

Conducted by: Florida Agricultural Experiment Station.

Conducted at: Gainesville, Florida.

Period: November 11, 1916 to January 17, 1917.

Purpose: To compare the feeding value of peanut, velvet bean, and cottonseed meal in milk production.

Procedure and conditions: Nine cows were selected from the dairy herd and divided into three lots of three cows each. The feeding test was divided into three periods of 20 days each with 4 days between periods of changing feeds. This was considered advisable so that it would not be necessary to make a sudden change in feed.

The feeds in this test were not fed in equal amounts but in as nearly equivalent food nutrients as possible.

All cows were fed wheat bran 9 pounds, silage 12 pounds; in addition, lot 1 received 3 pounds cottonseed meal; lot 2, 4 pounds peanut meal; and lot 3, 6 pounds velvet bean meal.

Table 7. Comparison of cottonseed meal, peanut meal, and velvet bean meal in milk production in Florida, 1916-1917.

	Lot 1	Lot 2	Lot 3
	3 pounds cottonseed meal	4 pounds peanut meal	6 pounds velvet beans
Pounds milk:			
First period	902.5	1,044.0	889.7
Second period	843.2	995.6	1,048.5
Third period	856.1	715.7	880.2
Total pounds milk three periods	2,601.8	2,755.3	2,818.4
Total gallons milk three periods	302.5	320.4	327.7

Reference: Florida Agricultural Experiment Station Press Bulletin 271, "Peanut, Velvet Bean, and Cottonseed Meal for Milk Production," pages 1 and 2, Gainesville, Florida, April 1917.

Feeding Cottonseed Meal to Dairy Cows and Calves

Conducted by: Michigan Agricultural Experiment Station.

Conducted at: East Lansing, Michigan.

Period: 1925. The test is to be continued over three generations.

Purpose: To determine the effect of heavy cottonseed meal feeding along with corn silage and hay of good quality.

Procedure and conditions: A long time feeding experiment was begun in 1925. It was planned to continue this experiment over three generations in order to bring out if possible the injurious effects of cottonseed meal.

Preliminary Test

The animals in lot 1, C43 and C47, received cottonseed meal as the principal source of protein, while those in lot 2, C44 and C45, received corn gluten meal and corn distiller's grain. Both groups received corn and oats and wheat straw ad libitum. Salt was before the animals at all times. Skim milk was fed to 180 days of age. These animals received an adequate ration up to the time they were placed on experiment which was 90 days of age. Stiffness and swelling around the hocks were observed in all four animals. C43, which received cottonseed meal, had a convulsion at 287 days of age. Seven days later another convulsion was observed. This calf also had diarrhea from time to time. It died at the age of 340 days. C47, which also received cottonseed meal, died at 275 days of age. This animal did not become blind or manifest tetany although the ration fed injured its health.

Calves C44 and C45, which were fed a ration free from cottonseed meal, became blind, C44 at 347 days and C45 at 293 days of age. While neither calf died from the effects of their ration, their condition was so poor that C45 was killed and the ration of C44 changed.

Two lots of five Holstein heifers each were used in the first generation. Animals in lot 1 received cottonseed meal as the source of protein. Those in lot 2 received linseed meal as the source of protein. Lot 2 was used as a check since linseed meal is recognized as safe protein concentrate to use as a supplement for growing cattle and milking cows. The animals in both lots were placed on experiment at 90 days of age and fed skim milk until 150 days of age. They were fed throughout the experiment all the timothy hay and corn silage they would clean up. Bonemeal was fed as 2 percent of the protein concentrate to both lots of animals. The animals had free access to salt to 18 months of age, after which salt was added as 1 percent of the concentrate.

The animals in lot 2 were fed like those in lot 1 except that old process linseed meal replaced cottonseed meal in the ration.

After first calving the animals in both lots were fed protein according to the upper limits of the Morrison feeding standard from cottonseed meal in lot 1 and linseed meal in lot 2. The protein in the other feeds was excess protein. Since linseed meal contained less protein than cottonseed meal, it was necessary to feed more linseed meal than cottonseed meal.

The different batches of cottonseed meal used in this investigation during the first 3 years were tested to determine whether or not the cottonseed meal would produce so called "cottonseed meal injury" when fed with an adequate ration. The first batch which was fed during the first 9 months was the same as that fed to C43 and C47. The second batch along with wheat straw, corn, oats, bonemeal and salt was fed a Holstein bull calf. It was placed on experiment at 96 days of age. Skim milk was fed to 150 days of age. Death occurred as a result of convulsion at 301 days of age. The third batch was fed to C80, a Holstein bull calf which was placed on the same ration as that fed C70, except that the cottonseed meal was of a different lot, at 94 days of age. This animal died at 361 days of age with the characteristic symptoms of cottonseed meal injury. It was emaciated, scoured badly, and became partially blind about six weeks before death.

Health. There has been but very little difference in the health of the two lots of animals.

Hide and Hair. The difference between the sleekness of coat, pliability of hide, and condition of the animals fed the cottonseed meal and linseed meal was so small that the judges were unable to distinguish between the two lots of heifers.

Effect of Heavy Cottonseed Meal Feeding on Reproduction and Milk Production. The only abortion occurring this far in this investigation was that of G8, which received linseed meal. G8's second calf was carried 240 days and weighed only 35 pounds. It was weak and died 8 hours after birth. This abortion cannot be attributed to the effects of the ration.

During heavy production as much as 17.3 pounds of cottonseed meal was fed daily for several months without any noticeable deterimental results.

Table 8. The effect of heavy cottonseed meal feeding with good roughage, East Lansing, Michigan, 1925.

	Average daily lbs. C.S.M. or L.O.M. fed	Pounds milk produced	Pounds butterfat produced
		Six months to first calving	
1. Cottonseed meal	2.3	——	——
2. Linseed oil meal	2.9	——	——
		First to second calving	
1. Cottonseed meal	6.8	9,861	345.5
2. Linseed oil meal	7.7	8,204	289.7
		Second to third calving	
1. Cottonseed meal	7.5	11,322	382.9
2. Linseed oil meal	9.3	10,171	371.7
		Third to fourth calving	
1. Cottonseed meal	8.4	12,444	432.4
2. Linseed oil meal	9.4	10,771	371.7

All the cattle in this test received all the timothy hay and corn silage they would eat in addition to the cottonseed meal.

Reference: The Jersey Bulletin and Dairy World, pages 1553 and 1572, "Cottonseed Meal As A Feed for Dairy Cattle," October 26, 1932, Indianapolis, Indiana.

A Comparison of Three Protein Concentrates and Two Leguminous Roughages in Milk Production

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: December 28, 1914 to June 28, 1915.

Purpose: To determine the type of protein-carrying concentrates and leguminous roughages best adapted for maximum and economical milk yield.

Procedure and conditions: The test covers a period of 180 days, divided into 6 periods of 30 days each. Fifteen purebred cows from the Experiment Station were divided into three lots of five cows each. Lot 1 contained four Jerseys and one Ayrshire; lot 2, five Jersey; and lot 3, four Jersey and one Ayrshire. The three protein-carrying concentrates under test were cottonseed meal, linseed meal, and gluten feed. The hay fed was alfalfa hay and soybean hay. The following table gives the feeds each lot received during the period of the test.

Table 9. Showing periods of feeding and rations received by the three lots of cows, Lafayette, Indiana, 1914-1915.

	Length of experiment, 180 days, divided into 6 periods of 30 days each					
Lot no.	First period	Second period	Third period	Fourth period	Fifth period	Sixth period
1	ground corn cottonseed meal alfalfa hay corn silage	ground corn gluten feed soybean hay corn silage	ground corn linseed meal alfalfa hay corn silage	ground corn cottonseed meal soybean hay corn silage	ground corn gluten feed alfalfa hay corn silage	ground corn linseed meal soybean hay corn silage
2	ground corn linseed meal alfalfa hay corn silage	ground corn cottonseed meal soybean hay corn silage	ground corn gluten feed alfalfa hay corn silage	ground corn linseed meal soybean hay corn silage	ground corn cottonseed meal alfalfa hay corn silage	ground corn gluten feed soybean hay corn silage
3	ground corn gluten feed alfalfa hay corn silage	ground corn linseed meal soybean hay corn silage	ground corn cottonseed meal alfalfa hay corn silage	ground corn gluten feed soybean hay corn silage	ground corn linseed meal alfalfa hay corn silage	ground corn cottonseed meal soybean hay corn silage

The grain mixture was compounded according to a standard that would insure a uniform nutritive ratio of all the rations tested. The corn and cottonseed meal were mixed in the proportion of 16 parts corn to 1 part cottonseed meal when fed in connection with alfalfa hay. When the same grain ration was fed in connection with soybean hay, the grain mixture contained 1 part cottonseed meal for each 10 parts corn. When linseed meal was substituted for cottonseed meal and the grain ration fed with alfalfa hay, the mixture contained 1 part linseed meal to 14 parts corn. The ratio was reduced to seven parts corn and one part linseed meal when soybean hay was substituted for the alfalfa hay. One part gluten feed was fed to eight parts corn, when fed in connection with alfalfa hay, and one part gluten feed to four parts corn when fed in connection with soybean hay.

Table 10. A comparison of three protein concentrates and two leguminous roughages in milk production, Indiana, 1914-1915.

	Av. weight at beginning of test	Cottonseed meal, alfalfa hay	Cottonseed meal, soybean hay	Linseed meal, alfalfa hay	Linseed meal, soybean hay	Gluten feed, alfalfa hay	Gluten feed, soybean hay
Av. body weight	840.3	875.7	888.6	878.5	888.6	878.1	890.4
Loss or gain in weight, lbs.		35.4	12.9	—10.1	10.1	—10.5	12.3
Av. daily milk produced, lbs.		20.18	19.93	19.85	17.31	18.89	17.98
Av. daily fat, lbs.		.9244	.9346	.9064	.8161	.8822	.8246

Reference: Indiana Agricultural Experiment Station Bulletin 203, "Test of Three Protein Concentrates and Two Leguminous Roughages in Milk Production," pages 4, 5, 7, 8, 9, and 10, tables 1, 5, and 6, Lafayette, Indiana, August 1917.

Soybeans for Dairy Cows

Conducted by: South Dakota Agricultural Experiment Station.

Conducted at: Brookings, South Dakota.

Period: 1925.

Purpose: To compare soybean hay with alfalfa hay as a feed for dairy cows.

Procedure and conditions: Four cows were used for each trial. They were kept in ordinary stalls so constructed that each animal could be fed separately. A small metal tank was placed between two mangers in which water was kept before the cows at all times.

The experimental trials were divided into 40-day periods. The first 10 days of each period were taken as the transition period. The 30-day periods were further divided into 10-day periods.

The cows were hand milked twice a day. The cows were allowed to exercise in a dry lot on nice days. They did not get as much exercise as the cows in the general herd, but sufficient so that this should not be a factor in influencing the results. The cows were curried twice a day. Salt and water were kept before them at all times. They were weighed regularly and the average of three successive weighings taken as the average weight. Ten-day composite milk samples were taken during the entire time of each experiment.

The Morrison feeding standard was used in balancing the rations, which were changed as often as milk production and body weight made it necessary. The cows were fed twice a day. The alfalfa hay, soybean hay, and silage were grown on the college farm, while the corn and oats were grown on farms nearby. The oil meal and soybeans were purchased from the local elevator. The soybeans were grown in South Dakota. All grains were ground, including the soybeans. The alfalfa and soybean hays were fed without cutting. The grain mixture for each cow was fed on the silage in a feed box and the alfalfa and soybean hays were fed in a tight manger. All feeds refused by the cows were weighed back and analyzed.

All grains used were of good quality except the corn in the last trial. This was of poor quality, being very low in ether extract. The soybean hay was not as good quality as the alfalfa, having in it considerable weeds, as well as being coarser than is desired for good forage.

Table 11. Soybeans for dairy cows, South Dakota, 1925.

	Oil meal vs. ground soybeans*		Alfalfa vs. soybean hay	
	Oil meal	Soybeans	Alfalfa hay	Soybean hay
Alfalfa hay, lbs	1,680.5	1,567.0	1,307.5	--------
Corn silage, lbs.	4,090.0	4,130.0	3,266.0	3,286.8
Corn, lbs.	483.0	467.0	561.7	570.0
Oats, lbs.	422.0	405.0	477.0	480.0
Oil meal, lbs.	237.6	--------	109.2	120.0
Soybean hay, lbs.	--------	--------	--------	1,212.6
Milk, lbs.	2,830.6	2,951.9	2,706.5	2,678.1
Fat, lbs.	118.67	120.33	132.29	133.3

*Average of two trials.

Reference: South Dakota Agriculturarl Experiment Station Bulletin 215, "Soybeans for Dairy Cows," pages 5, 6, and 8, table 4, Brookings, South Dakota, June 1925.

Comparison of Ground Soybeans with Linseed Oil Meal as a Protein Supplement in the Dairy Ration

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: February 1 to May 2, 1923.

Purpose: To compare ground soybeans with linseed oil meal as a protein supplement in the dairy ration.

Procedure and conditions: Two lots with four cows in each lot were used for this test. Each lot contained three Holsteins and one Jersey.

The cows were fed all the alfalfa hay and corn silage they could eat. This roughage was weighed to each cow and amounts refused were weighed back.

The grain mixture fed during the trial was composed of the following feeds:

400 pounds ground corn
200 pounds ground oats
200 pounds ground soybeans or linseed meal

The ground soybeans used in this trial were not whole beans, but were small and broken beans cleaned from soybeans that were to be used for seed.

The protein supplement fed each lot during each of the three feeding periods is given in the following table:

Period	Lot 1	Lot 2
1	Ground soybeans	Ground soybeans plus mineral
2	Linseed oil meal	Linseed oil meal
3	Ground soybeans	Ground soybeans plus mineral

Table 12. Comparison of ground soybeans with linseed oil meal as a protein supplement, Indiana, 1923.

	Period 1		Period 2		Period 3	
	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2
Av. body weight, lbs.	997	970	1,010	981	1,026	978
Feed consumed:						
Grain, lbs.	632.0	698.5	603.5	668.5	612.0	646.5
Silage, lbs.	2,523.0	2,520.0	2,646.0	2,520.0	2,646.0	2,520.0
Hay, lbs.	837.0	840.0	840.0	840.0	815.4	812.4
Production:						
Milk, lbs.	2,288.5	2,592.9	2,203.9	2,433.7	2,219.5	2,416.0
Fat, lbs.	84.9	90.5	80.7	85.6	81.9	83.4
Test, percent	3.71	3.49	3.66	3.51	3.69	3.44

Reference: Indiana Agricultural Experiment Station Bulletin 289, "Soybean Oil Meal and Ground Soybeans as Protein Supplements in the Dairy Ration," pages 4, 15, and 16, tables 1 and 2, Lafayette, Indiana, December 1924

Comparison of Soybean Oil Meal with Linseed Oil Meal as a Protein Supplement in the Dairy Ration

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: February 1 to May 9, 1923.

Purpose: To compare soybean oil meal with linseed oil meal as a protein supplement in the dairy ration.

Procedure and conditions: Two lots of cows were used; four cows in lot 1 and three in lot 2.

The cows were fed all the alfalfa hay and corn silage they could eat. The grain mixture fed during the trial was composed of the following:

400	pounds ground corn
200	pounds ground oats
200	pounds soybean oil meal or linseed oil meal

A mineral mixture made up of 2 parts bonemeal, 1 part 16 percent acid phosphate, and 1 part slaked lime, was fed in each trial to one lot of cows receiving soybean oil meal to determine whether any definite effect could be observed from the addition of the minerals.

The mineral supplement was fed in the grain mixture at the following rate:

1½ ounces per day for each 10-20 pounds milk
2 ounces per day for each 20-30 pounds milk
2½ ounces per day for each 30-50 pounds milk

The protein supplement fed to each lot during each feeding period is as follows:

Period	Lot 1	Lot 2
1	Soybean oil meal	Soybean oil meal plus mineral
2	Linseed oil meal	Linseed oil meal
3	Soybean oil meal	Soybean oil meal plus mineral

Table 13. Comparison of soybean oil meal with linseed oil meal as a protein supplement in the dairy ration, Lafayette, Indiana, 1923.

	Period 1		Period 2		Period 3	
	Lot 1	Lot 2	Lot 1	Lot 2	Lot 1	Lot 2
Av. body weight, lbs.	1,096.0	1,142.0	1,096.0	1,146.0	1,089.0	1,151.0
Feed consumed:						
Grain, lbs.	746.5	543.5	758.5	484.5	719.0	469.5
Silage, lbs.	2,646.0	2,204.5	2,709.0	2,205.0	2,646.0	2,205.0
Hay, lbs.	840.0	711.0	840.0	705.0	788.0	682.8
Production:						
Milk, lbs.	2,891.0	2,089.9	2,702.2	1,967.9	2,618.8	1,866.5
Fat, lbs.	92.6	62.7	86.6	62.0	79.6	53.2
Test, percent	3.20	2.99	3.21	3.15	3.04	2.85

Reference: Indiana Agricultural Experiment Station Bulletin 259, "Soybean Oil Meal and Ground Soybeans as Protein Supplements in the Dairy Ration," pages 4, 8, and 9, tables 1 and 2, Lafayette, Indiana, December 1924.

Comparison of Soybean Oil Meal with Linseed Oil Meal as a Protein Supplement in the Dairy Ration

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: November 4, 1922 to January 26, 1923.

Purpose: To compare the value of soybean oil meal and ground soybeans with linseed oil meal as protein supplements in dairy ration.

Procedure and conditions: Three lots of three cows each were fed. These cows were all in good production and in each lot there was one Jersey and two Holsteins or Ayrshires so that the milk production and the fat test would be as nearly similar as possible. The feeding periods were 28 days in length, the first 7 days of which were not used in the comparisons as this was considered a preliminary period.

The cows were fed all the alfalfa hay and corn silage that they could eat. This roughage was weighed to each cow and amounts refused were weighed back.

The grain mixture fed to cows during this experiment was made up as follows:

300	pounds ground corn
200	pounds bran
100	pounds ground oats
100	pounds gluten feed
150	pounds either linseed oil meal or soybean oil meal

A mineral mixture made up of 2 parts bonemeal, 1 part 16 percent acid phosphate, and 1 part slaked lime was fed in each trial to one lot of cows receiving soybean oil meal to determine whether any definite effect could be observed from the addition of the minerals.

The mineral supplement was fed in the grain mixture at the following rate:

1½ ounces per day for each 10-20 pounds milk
2 ounces per day for each 20-30 pounds milk
2½ ounces per day for each 30-50 pounds milk

The linseed oil meal fed during this period had a 34 percent crude protein guarantee. The soybean oil meal was old process meal.

A rotation method was used for comparison. The grain ration of each lot was changed at the beginning of each period, so that at the end of the three feeding periods each lot had received linseed oil meal, soybean oil meal, and soybean oil meal plus mineral in the grain ration.

The protein supplement used for each lot during each of the three feeding periods is given below.

Feeding period	Lot 1	Lot 2	Lot 3
1	Linseed oil meal	Soybean oil meal	Soybean oil meal plus mineral
2	Soybean oil meal	Soybean oil meal plus mineral	Linseed oil meal
3	Soybean oil meal plus mineral	Linseed oil meal	Soybean oil meal

Table 14. Soybean oil meal with linseed oil meal as a protein supplement in the dairy ration, Indiana, 1922-23.

	Lot 1	Lot 2	Lot 3
PERIOD 1			
Average body weight, lbs.	1,118	1,103	1,091
Feed consumed:			
Grain, lbs.	524	547.5	708.1
Silage, lbs.	2,134.8	2,177.0	1,988.5
Hay, lbs.	679.0	695.0	692.0
Production:			
Milk, lbs.	1,835.5	2,039.2	2,820.0
Fat, lbs.	69.5	71.6	101.5
Test, percent	3.79	3.50	3.60
PERIOD 2			
Average body weight, lbs.	1,115	1,105	1,094
Feed consumed:			
Grain, lbs.	479.5	510.0	695.5
Silage, lbs.	2,013.5	1,949.5	2,000.2
Hay, lbs.	705.7	711.2	626.2
Production:			
Milk, lbs	1,707.0	1,914.3	2,733.2
Fat, lbs.	64.4	69.8	89.6
Test, percent	3.77	3.64	3.27
PERIOD 3			
Average body weight, lbs.	1,136	1,120	1,112
Feed consumed:			
Grain, lbs.	469.5	523.0	721.2
Silage, lbs.	2,006.0	1,949.5	2,012.7
Hay, lbs.	710.2	704.2	666.9
Production:			
Milk, lbs.	1,716.1	1,938.6	2,789.4
Fat, lbs.	64.1	67.3	93.5
Test, percent	3.73	3.46	3.35

Reference: Indiana Agricultural Experiment Station Bulletin 289, "Soybean Oil Meal and Ground Soybeans as Protein Supplements in the Dairy Ration," pages 4, 5, and 6, tables 1 and 2, Lafayette, Indiana, December 1924.

Narrow versus Medium Rations for Cows in North Carolina

Conducted by: North Carolina Agricultural Experiment Station.

Conducted at: Raleigh, North Carolina.

Period: 1910.

Purpose: To determine the relative economy of a narrow ration and a medium wide ration. In a wide ration there is less protein in proportion to carbonaceous matter than in a narrow ration.

Procedure and conditions: This experiment was duplicated after the first trial to see if the results could be substantiated. In both trials the kind, amount, and proportion of feed as well as general methods were the same. In the first trial the narrow ration was fed during the first and third periods and the medium ration during the second period. In the second trial the medium ration was fed during the first and third periods and the narrow during the second period. The number of cows in the first trial was eight while only five were used in the second trial.

In periods 1 and 3 a narrow ration consisting of 5 pounds cottonseed meal, 4 pounds wheat bran, 3 pounds corn meal, and 50 pounds corn silage was fed. During period 2 the ration was the same as in periods 1 and 3 except that 2.5 pounds of cottonseed meal were replaced by 2.5 pounds of corn meal. Each period was preceded by 10 days preliminary feeding.

The milk from each cow was weighed daily and composite samples were tested weekly by the Babcock test. The cows were weighed once a week throughout the experiment.

Table 15. Narrow versus medium rations for cows in North Carolina, 1910.

	Period 1 Narrow ration	Period 2 Medium ration	Period 3 Narrow ration	Average period 1 and 3
FIRST TRIAL:				
Total liveweight, lbs.	6,623.0	6,580.0	6,593.0	6,610.0
Milk produced, lbs.	4,978.3	4,668.3	4,279.3	4,628.8
Butterfat produced, lbs.	237.7	206.0	205.6	221.5
Butterfat produced, percent	4.90	4.67	4.92	4.91
SECOND TRIAL:				
Total liveweight, lbs.	4,252.0	4,290.0	4,351.0	4,301.0
Milk produced, lbs.	3,274.3	3,076.5	2,672.0	2,973.1
Butterfat, produced, lbs.	155.47	159.82	141.58	148.52
Butterfat, percent	4.82	5.28	5.40	5.11

Reference: North Carolina Agricultural Experiment Station Bulletin 213, "Feeding Experiments with Cows and Calves," pages 89, 90, 91, 92, and 93, tables 2 and 4, Raleigh, North Carolina, October 1910.

Grains or Carbohydrate Feeds

In setting up a feeding system to use in milk production, grains such as corn, oats, barley, and rye are often included in the ration. These feeds supply small to medium amounts of protein as well as a relatively high percentage of total digestible nutrients. The amounts of these feeds included in a dairy cow's ration should no doubt depend largely on the productive capacity of individual farms where the feed is to be used. By carefully examining the results of experimental tests, cases can be found where satisfactory production has been obtained without the use of grain feeds. Provided feeds of this type can be produced economically they no doubt have a place in the ration. The results of experiments should be examined carefully before planning to use purchased grain feeds in high quantities.

Velvet Beans versus Corn for Milk Production

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: 8 weeks, 1922-23.

Purpose: To determine the feeding value of velvet beans when supplementing a basal ration of corn meal, wheat bran, and cottonseed meal.

Procedure and conditions: Sixteen cows divided into four groups as closely comparable as possible, were fed a period of 8 weeks following a preliminary period of 1 week.

Rations fed the four groups of cows

	Group 1	Group 2	Group 3	Group 4
Cottonseed meal, lbs.	100	50	75.0	25.0
Wheat bran	150	75	112.5	37.5
Corn meal	250	125	187.5	62.5
Velvet bean feed	—	250	125.0	375.0
Total	500	500	500.0	500.0

The velvet beans in pods were ground into a feed of about the coarseness of corn meal or cottonseed meal. The amount of grain fed to individual cows was changed weekly according to their milk and butterfat yield the preceding week. All cows were on a good Bermuda grass pasture and were milked twice daily. Table 16 gives the amount of feed consumed and milk produced.

Table 16. Velvet beans versus corn for milk production, South Carolina, 8-week period, 1922-23

	Group 1	Group 2	Group 3	Group 4
Number cows	4	4	4	4
Feed per 100 lbs. milk, lbs.	36.14	40.40	34.51	33.30
Cottonseed meal	7.27	6.06	3.45	1.57
Wheat bran	10.70	9.09	5.18	2.35
Corn meal	18.17	15.15	8.63	3.91
Velvet bean feed		10.10	17.25	23.47
Total production per cow, lbs.	1,285.52	1,153.00	1,282.40	1,190.60
Average daily production, lbs.	22.95	20.59	22.90	21.26
Average percent fat, lbs.	3.53	4.00	3.86	3.83
Average gain or loss in weight, lbs.	13.00	—17.00	—43.00	13.00

Reference: "Agricultural Education," Volume 5, No. 9, pages 136 and 137, table 9, Clemson, South Carolina, May 1929.

Velvet Beans versus No Velvet Beans as a Feed for Milk Production

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: 8 weeks, 1922-23.

Purpose: To determine the feeding value of velvet beans.

Procedure and conditions: Sixteen cows were divided into two groups as nearly comparable as possible and fed a period of 8 weeks following a preliminary period of 1 week.

Rations fed

	Group 1	Group 2
	Lbs.	Lbs.
Cottonseed meal	200	100
Wheat brain	400	200
Corn meal	400	200
Velvet bean feed		500
Total	1000	1000

All cows were fed silage and hay. The two groups received the same total amounts of silage and hay but all grain and silage not eaten was deducted from the amount charged the cow.

The results of the test are given in table 17.

Table 17. Comparison of the feeding values of a ration with and without velvet beans, South Carolina, 1922-23

	Group 1	Group 2
Number cows	8	8
Feed per 100 pounds milk, lbs.	44.17	45.11
Cottonseed meal	8.83	4.51
Wheat bran	17.67	9.02
Corn meal	17.67	9.02
Velvet bean feed	--------	22.56
Total production per cow, lbs.	1,328.32	1,336.72
Average daily production per cow, lbs.	23.72	23.87
Average percent fat	4.12	4.37
Average gain or loss in weight, lbs.	8.50	20.60

Reference: "Agricultural Education," Volume 5, No. 9, pages 137 and 138, table 10, Clemson, South Carolina, May 1929.

Limited-Grain Feeding and All-Year Pasture for Dairy Cows

Conducted by: Tennessee Agricultural Experiment Station.

Conducted at: Columbia, Tennessee.

Period: February 15, 1933 to February 15, 1937.

Purpose: To compare limited grain feeding and all-year pasture with full grain feeding and summer pasture.

Procedure and conditions: The cattle used were registered Jerseys divided into two groups as nearly equal as possible in milk production, age, period of lactation, and condition. Heifers, as they came fresh were added to the groups alternately. From time to time, for various reasons, cows were dropped from the experiment. In number of cows, the groups were kept as nearly balanced as possible so that each group consisted of seven cows, on the average, for the entire period. A total of 14 cows were used in each group.

Ration:

Group 1—**Full-grain:**

Alfalfa hay, ad libitum
Corn silage, 3 lbs. per 100 lbs. liveweight
Concentrates, 1 lb. to 3 lbs. milk
Pasture, April to October, inclusive

Group 2—**Half-grain:**

Alfalfa hay, ad libitum
Corn silage, 3 lbs. per 100 lbs. liveweight
Concentrates, 1 lb. to 6 lbs. milk
Pasture, winter and summer (as weather permitted)

In mid-summer the pasture included bluegrass, lespedeza, and Sudan grass. During the remainder of the year it included bluegrass, hop clover, white clover, barley, and rye. The concentrate mixture consisted of equal parts of cottonseed meal, corn-and-cob meal and ground oats. In all cases the hay used was medium-to-good alfalfa. The silage was a good grade of corn-sorghum.

Table 18. Production and feed consumed per cow per year, Tennessee 4-year average, 1933-37

	Group 1	Group 2
Milk produced, lbs.	6,442.0	6,265.0
Butterfat produced, lbs.	376.0	367.0
Feed consumed per cow per year:		
Grain	Full, 1:3	Half, 1:6
Concentrates, lbs.	1,836.0	974.0
Hay, lbs.	4,982.0	4,328.0
Pasture, days	198.0	346.0

Reference: Tennessee Agricultural Experiment Station Circular 78, "Limited-Grain Feeding and All-Year Pasture for Dairy Cows," pages 1-4, tables 1 and 2, Knoxville, Tennessee, January 1942.

Planes of Feeding Grain to Dairy Cows

Conducted by: New Mexico Agricultural Experiment Station.

Conducted at: State College, New Mexico.

Period: Test 1, February 12 to April 11, 1910.
Test 2, February 4 to April 11, 1911.

Purpose: To determine whether it is necessary to supplement first-class alfalfa hay with grain feed.

Procedure and conditions: The first year there were two lots of five cows each in the experiment, and the second year six cows in each lot. The lots were fed alfalfa in separate corrals and the grain was fed in the milking stable at milking time.

This experiment extended over two periods of 30 days each, with a 5-day interval to change the feed. The grain ration consisted of equal parts of corn and bran. During the first period, lot 1 received 6 pounds of grain per head daily and all the alfalfa they would clean up well; and lot 2 alfalfa alone, all they would clean up. For the second period the lots were interchanged and lot 1 received the alfalfa alone.

Table 19. **Alfalfa and grain versus alfalfa alone, State College, New Mexico, 1910-11**

	TEST 1								
	Lots fed alfalfa plus grain				Lots fed alfalfa alone				Increase due to grain
	Period 1 Lot 1	Period 2 Lot 2	Both periods	Av. per cow per day	Period 1 Lot 2	Period 2 Lot 1	Both periods	Av. per cow per day	
Alfalfa fed, lbs.	4,512.0	3,126.0	7,638.0	26.25	5,333.0	4,310.0	9,643.0	32.0	—2,005
Grain	900.0	900.0	1,800.0	6.00	......	......	......	...	1,800
Milk produced, lbs.	2,028.0	1,900.0	3,928.0	13.10	1,661.0	1,793.0	3,454.0	11.5	474
Butterfat produced, lbs.	102.8	105.2	208.0	.693	100.8	88.3	188.8	.629	19.2
	TEST 2								
Alfalfa fed, lbs.	4,376.0	3,995.0	8,371.0	25.0	5,390.0	4,861.0	10,251.0	30.5	—1,880
Grain fed, lbs.	1,136.0	1,316.0	2,452.0	7.33	...	......	...	...	2,452
Milk produced, lbs.	2,935.0	2,546.0	5,481.0	16.3	2,600.0	2,359.0	4,959.0	14.75	522
Butterfat produced, lbs.	133.0	108.0	241.8	.72	113.0	103.6	216.6	.64	25.2
Change in weight, lbs.	250.0	262.0	512.0	1.5	80.0	—127.0	—47.0	—1.4	559.0

Reference: New Mexico Agricultural Experiment Station Bulletin 98, "Economic Feeding for Milk Production in New Mexico," pages 17, 18, 19, and 20, tables 6 and 7, Las Crues, New Mexico, June 1915.

The Relation of Grain Feeding to Milk Production

Conducted by: Pennsylvania Agricultural Experiment Station.

Conducted at: State College, Pennsylvania.

Period: 1938-41.

Purpose: To show the relation of grain consumption to milk production using Haecker's standard as the basis for the level of grain feeding.

Procedure and conditions: Twenty-four cows (14 Holstein and 10 Brown Swiss) were fed a maintenance ration of alfalfa hay and corn silage twice daily, according to their weight. The production ration was largely from grain fed three times daily at 70, 80, 90, 100, 110, and 120 percent levels of the Haecker feeding standard. The cows were milked three times a day and were allowed daily exercise but received no pasture, barn feeding being practiced throughout the year. These different levels of grain feeding were continued for two full lactation periods.

The grain mixture, containing approximately 14 percent of crude protein, 11 percent digestible protein, and 70 percent total digestible nutrients, was made up in such a way as to guard against any deficiency in minerals or vitamins.

At the end of the second lactation period it was evident that even the cows on the most liberal grain allowance had not reached the point where additional grain would give no further increase in milk production. It was therefore decided to allow a group of cows all the grain they would eat during the third year. Twelve of the cows were Holsteins and 10 were Brown Swiss. This group included some of the cows that had been fed grain at a high level for the 2 previous years; hence, certain cows were on a high level of grain feeding for 3 years in succession.

Table 20. Relation of grain consumption to milk production of dairy cows, Pennsylvania, 1938-41

Level of grain feeding based upon Haecker's Standard	Yearly record	Grain consumed during lactation	Milk produced (4 percent fat corrected basis)	Milk yield per pound of grain fed	Pounds milk for each additional pounds of grain (4 percent fat corrected basis)
Percent	Number	Pounds	Pounds	Ratio	Pounds
70	2	1,511	7,993	1:5.3	----
80	10	2,248	8,816	1:3.9	....
90	9	3,455	10,253	1:3.0	1.4
100	9	4,221	11,518	1:2.7	1.1
110	10	4,751	10,879	1:2.5	1.0
120	4	6,221	12,170	1:2.0	.8
Unlimited (123.1)	22	7,300	12,756	1:1.75	....

Reference: Pennsylvania Agricultural Experiment Station Bulletin 424, "The Relation of Grain Feeding to Milk Production," pages 2 and 4, tables 1 and 2, State College, Pennsylvania, March 1942.

Feeding Rye and Barley to Dairy Cows

Conducted by: Montana Agricultural Experiment Station.

Conducted at: Bozeman, Montana.

Period: Two 42-day periods in 1929-30.

Purpose: To compare the feeding of rye with barley to dairy cows.

Procedure and conditions: In this trial 12 cows were fed for two 42-day periods by the reversal plan. The cows that were fed rye in the first period were fed barley the second period and the cows that were fed barley the first period were fed rye the second period. Both lots received all the alfalfa hay they would consume and nearly equal amounts of grain. The grain mixture contained 40 percent by weight of either ground rye, or ground barley. The rest of the grain mixture consisted of 35 percent of rolled oats, 20 percent of wheat bran, and 5 percent of linseed oil meal. The amount of grain fed varied with the milk flow for the individual cows.

The milk from the two groups of cows was kept separate and the cream churned. The butter from the rye-fed cows was fully equal in quality to that from those fed barley, while the buttermilk from the former cows was superior to that of the latter. The results of the test are shown in table 21.

Table 21. Rye versus barley for dairy cows, Montana, 1929-30

	Rye lot	Barley lot
Number of cows in each lot	12	12
Number of days on trial	42	42
Average gain in weight, lbs.	2	7
Average daily production per cow:		
Milk, lbs.	29.80	29.60
Butterfat, lbs.	1.01	1.01
Average ration eaten per cow daily:		
Hay, lbs.	28.60	28.70
Grains, lbs.	10.06	9.95

Reference: Montana Agricultural Experiment Station Bulletin 282, "Feeds for Dairy Cattle," pages 17 and 18, table 13, Bozeman, Montana, December 1933.

Grain versus No Grain for Dairy Cows

Conducted by: Wyoming Agricultural Experiment Station.

Conducted at: Laramie, Wyoming.

Period: 152 cows: 1924-1933.
43 cows: 1927-1933.

Purpose: To determine whether or not grain is necessary or economical in milk production.

Procedure and conditions: Thirteen head of purebred Holstein cows raised at the University Stock Farm were fed in this experiment for a total of 30 lactation periods. Ten of the 13 head whose growth periods up to 27 months of age have been previously reported were continued for one or more lactation periods; while 3 more were added during the course of the experiment.

The cows were fed in two groups. Group 1 received no grain during the winter and summer months except for a 2-week period one summer when the pasture became extremely short and no alfalfa hay was at hand to use as a supplement. Group 2 received ground barley during the winter months, fed at the rate of 1 pound to 5 pounds of milk produced. Both groups received the same treatment on pasture, no grain being fed except for the brief period mentioned.

During the winter months all cows had access to alfalfa hay in a hay bunk. The cows were allowed hay in slight excess of that which they would clean up. Second cutting alfalfa was fed, and for the most part, would grade U. S. No. 2. Block salt and water were available at all times. During the summer the cows were allowed to graze on irrigated tame grass and sweet clover pasture. The cows were on this pasture day and night for about 100 days each year.

Table 22. Milk production and persistency of production with and without grain, Wyoming, 1924-33

	Group 1 (No grain)	Group 2 (Grain supplement)
Number cows	5	6
Number lactations	16	9
Production:		
Milk, lbs.	9,386	10,180
Fat, lbs.	310.4	323.1
Persistency of production (lbs. per day)		
Early peak	45.5	43.0
20th week	32.3	33.6
39th week	18.1	22.1

Reference: Wyoming Agricultural Experiment Station Bulletin 202, "Grain versus No Grain for Dairy Cows," pages 7, 8, 14, and 17, tables 3 and 5, Laramie, Wyoming, May 1934.

Planes of Feeding Grain to Dairy Cows

Conducted by: U. S. Dairy Experiment Station.

Conducted at: Near Fallon, Nevada.

Period: 1926-1929.

Purpose: To determine whether it is necessary to supplement first class alfalfa hay with grain feed.

Procedure and conditions: In 1925, 21 grade Holstein cows were purchased from farmers of the Newlands project for this test.

The feeding and milking shed was continuously open on the east side so that the cows received about the same exposure to the weather as they do on most farms in Nevada. Stanchions were used only during the milking period; at other times the animals are free to pass in or out of the shelter .

The barn and corrals were divided into five equal sections 25′ x 200″. The herd was divided into five groups, each cow to remain in the same group through the remainder of her productive life.

The plan of the feeding experiment was as follows:

Group 1. Cows to receive alfalfa hay continuously without any supplementary feed.

Group 2. Cows to receive alfalfa hay, 1 pound grain for approximately 5 pounds of milk produced, no other feed.

Group 3. Cows to receive alfalfa hay continuously, grain each alternate lactation period. During the first year (1926) they were fed grain every other month.

Group 4. Cows to try the effect of various feeds available at different seasons of the year, such as silage in winter, pasture in summer, beets and mangels when available. No grain.

Group 5. Cows to be fed in the same manner as those of group 4 except that they receive a supplementary grain ration.

In group 1, four of the cows were retained without change throughout the 4 years of the experiment, also four cows in group 2, and all five cows in group 3. Groups 4 and 5 were never built up to the full quota of five cows each; these groups were so frequently interferred with by death or sickness that the results can hardly be used.

Selected alfalfa hay was used from the beginning of the experiment. It was invariably of good quality and contained little foreign material.

When the herd was first assembled, the grain-fed cows were given rolled barley unmixed with other concentrates, but so much bloat resulted that it soon became necessary to feed millrun with barley in the proportion of two-thirds barley and one-third millrun. Bloating occurred less often but was still dangerous. To lessen still further the danger from bloat, the grain mixture was changed in January 1928, to one-third barley, and two-thirds corn and millrun.

Table 23. Various methods of apportioning grain to dairy cows, 4-year average Nevada, 1926-1929

	Group 1	Group 2	Group 3
Average per cow per lactation period	Alfalfa hay	Alfalfa hay	Alfalfa hay continuously with grain fed on alternate lactations
	Pounds	Pounds	Pounds
Milk production	8,644	10,352	9,163
Butterfat production	304	359	326
Hay consumption	13,458	12,408	13,057
Grain consumption	none	2,160	774
Total digestible nutrients consumed per pound of butterfat produced (conversion factor)	24	24	23.1

Reference: Nevada Agricultural Experiment Station Bulletin 119, "Feeding Experiment with Dairy Cows," pages 5, 6, 7, 9, 11, and 14, tables 1, 2, 4, and 7, Reno, Nevada, August 1930.

Planes of Feeding Grain to Dairy Cows

Conducted by: Group 1, U. S. Field Station, Huntley, Montana.
Group 2, Five U. S. Field Stations.

Conducted at: Group 1, Huntley, Montana.
Group 2, Beltsville, Maryland; Huntley, Montana; Mandan, N. D.; Ardmore, S. D.; and Woodward, Oklahoma.

Period: Group 1. 1919-1926.
Group 2. After 1926.

Purpose: To determine the economy of various percentages of grain fed in the dairy ration.

Procedure and conditions: In the first experiment the cows were fed four kinds of roughage and pasture but the total digestible nutrients from roughage are reduced to pounds of alfalfa hay required to furnish them in order to be comparable to the second experiment. In the second experiment, the roughage ration consists of alfalfa hay alone.

The first experiment—Group 1 (10 cows):

Three planes of feeding. The experiment was conducted to compare the effects of three planes of feeding on milk production and on the economy of production: (1) Cows were fed roughage consisting of alfalfa hay, corn silage, roots, and irrigated tame-grass pasture, and 1 pound of a standard grain mixture for each 3 pounds of milk produced daily (full grain ration); (2) the same cows were fed the same kind of roughages with 1 pound of grain mixture to each 6 pounds of milk produced (limited grain ration); and (3) the same cows were fed the above roughages but received no grain (roughages ration). Ten cows have completed yearly records on three rations.

The grain mixture used in the rations of both the full-grain and limited-

Table 24. Full grain feeding of dairy cows as compared to feeding limited grain or roughage alone—Five U. S. Field Stations, 1919-26

(Each figure given as average per cow)	Group 1, 10 cows, Huntley, Mont.			Group 2, 15 cows	
	Roughage alone 10 cows	Limited grain, 1 lb. grain to 6 lbs. milk (same 10 cows)	Full grain 1 lb. grain to each 3 lbs. milk (Same 10 cows)	Roughage alone	Full grain 1 lb. grain to each 3 lbs. milk (same 15 cows)
Milk production:					
Actual pounds	13,295	16,407	15,793	-------	-------
Calculated to maturity, lbs.	13,656	16,649	17,851	11,375	18,009
Milk production, percent of that of full grain ration	76.5	93.2	-------	63.2	-------
Butterfat:					
Actual pounds	464	576	544	-------	-------
Calculated to maturity, lbs.	478	584	620	402	621
Feeds consumed:					
Grain, lbs.	-------	2,710	5,266	-------	6,003
Alfalfa hay, lbs.	6,376	5,978	6,782	13,915	9,800
Corn silage, lbs.	11,234	12,076	8,501	-------	-------
Beet pulp, lbs.	65	2	244	-------	-------
Beets, lbs.	1,345	527	2,258	-------	-------
Days on pasture	132	138	120	-------	-------
Nutrients (digestible) consumed excluding pasture:					
Crude protein	804.39	1,088.68	1,471.04	-------	-------
Total digestible nutrients	4,977.64	6,484.69	9,015.33	-------	-------
Digestible nutrients for maintenance and production:*					
Crude protein	1,150	1,355	1,439.0	1,009.0	1,451.0
Total digestible nutrients, lbs.	7,943	9,158	9,690	7,180.0	9,758.0
Feeds needed to supply nutrients required:					
Alfalfa hay, lbs.	15,394	13,528	9,631	13,915.0	9,800.0
Grain, lbs.	none	2,745	5,950	-------	6,003.0
Age (year, months)	6-4	7-0	4-2	-------	-------
Weight, lbs.	1,240	1,331	1,238	1,279.0	1,429.0
Gain or loss in weight while on rations, lbs.	30	108	180	-------	-------
Dry period prior to test, days	78	55	56	-------	-------
Grain fed while dry, lbs.	132	111	186	-------	-------
Period carrying calf, lbs.	175	155	188	-------	-------

*According to Savage's Feeding Standard. U.S.D.A. Tech. Bul. 353

Reference: Mississippi Agricultural Experiment Station Bulletin 304, "Planning the Feeding of Farm Animals," pages 22, 23, and 27, table 16, State College, Mississippi.

grain groups was composed of 2 parts of mill feed*, 2 parts of ground oats, 2 parts of ground corn, and 1 part of linseed meal. Ten cows were used in the experiment, each cow completing a lactation period on each of the three planes at one time or another during the 7-year period, 1919-1926.

The second experiment—Group 2 (15 cows):

In calculating the amounts of grain needed to meet these requirements for maintenance and production, the authors used a grain mixture consisting of two parts corn, one part wheat, and one part oats. This grain mixture is not the one the two groups of cows actually received in the feeding experiments, but it consists of standard farm crops and was selected for use in the calculation to make the results of this study more applicable to farm conditions. Also, the roughage actually fed in the rations for group 1 consisted of corn silage, beet pulp, and pasture during the pasture season, as well as alfalfa hay, and for group 2 the roughage ration was alfalfa hay alone. In all cases the roughage requirements have been calculated in terms of alfalfa hay.

Milk and Butterfat Production by Dairy Cows on Four Different Planes of Feeding

Conducted by: United States Department of Agriculture, Bureau of Dairy Industry in cooperation with Utah Agricultural Experiment Station.

Conducted at: Logan, Utah.

Period: 1940.

Purpose: The comparison of four different rations, or so-called planes of feeding.

Procedure and conditions: Twelve registered and grade Holstein-Friesian cows were used in the test, each cow being fed throughout one complete lactation period on each of the following four rations, or so-called planes of feeding: Full-grain ration; ration 1 (alfalfa hay and pasture); ration 2 (alfalfa hay, pasture, and ground barley); and ration 3 (alfalfa hay, pasture, and corn silage).

The quantity of milk and butterfat produced on rations 1, 2, and 3 was compared with the quantity produced on the full-grain ration.

The full-grain ration consisted of alfalfa hay, corn silage, pasture in season, and a grain mixture made up of barley, 2 parts; oats, 1 part; and wheat bran, 1 part. The cows were fed the grain mixture at the rate of 1 pound a day for each pound of butterfat produced per week. Grain feeding was discontinued when butterfat production dropped below 20 pounds per month.

Ration 1 consisted of alfalfa hay alone, or pasturage alone when good pasture was available. Some hay was fed during the pasture season, however, when pastures became short.

Ration 2 consisted of alfalfa hay and pasture, with the addition of ground barley grain. The barley was fed at about the same rate both summer and winter.

Ration 3 consisted of alfalfa hay and pasture, with the addition of corn silage. Both the hay and corn silage were fed largely during the winter months, although a smaller percentage was fed during the pasture season when the pastures were short.

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*No commercial feed is available that is known as "mill feed," so an average of equal parts of hominy feed, rice polish, wheat bran, and wheat shorts was used in determing the nutrients contained. The analysis of this is 10.2 percent crude protein and 74.2 percent total digestible nutrients. Then the entire mixture averages 12.1 percent crude protein and 76.9 percent total digestible nutrients.

The barley was the Trebi variety, with a weight of 50 pounds to the bushel or slightly above. The oats were Swedish Select.

The alfalfa hay fed was principally of the first and third cutting, with a very small amount of second cutting. On an average, it is believed, the hay would grade U. S. No. 1, though no hay was actually graded.

The corn from which the silage was made was the Improved Leaming variety. It was well eared and was cut when a majority of the ears were well dented and the stalks and leaves were still of a good green color.

The pasture herbage consisted chiefly of Kentucky bluegrass and white clover, grading down to sedges and rushes in the lower areas.

The cows were milked twice daily by machine throughout each lactation period. During the winter months they were housed in a stanchion barn and for a part of each day, in good weather, they were allowed to run in an open lot that was well protected from the wind. During the winter months, and also during the pasture season, they received all their feed in individual mangers while they were stanchioned. All feeds, except pasturage, were weighed as fed and refused feed was weighed back. The cows had access to water in drinking cups in the barn and in a large watering trough in the barnyard, and to running spring water in the pastures.

Since these 12 cows were also being used in a breeding experiment, in which they had been fed the full-grain ration during their first lactation period to determine their inherent producing capacity, production records on the full-grain ration were already available for use in this four planes of feeding experiment. Subsequently, each cow was placed on each of the three rations, at the beginning of a dry period preceding calving.

Table 25. Production of dairy cows on four different planes of feeding, Utah, 1940

	Full-grain ration	Ration 1	Ration 2	Ration 3
Av. feed consumption per cow				
Alfalfa hay, lbs.	4,684	7,208	6,345	4,390
Corn silage, lbs.	4,787	----	----	9,052
Grain mixture, lbs.	2,388	----	----	----
Ground barley, lbs.		----	1,818	
Production of milk per pound of grain fed, lbs.	4.38	----	6.10	----
Pasture, days	120	135.3	148.8	151.5
Production:				
Milk, lbs.	10,349	8,571	10,964	9,029
Butterfat, lbs.	348.3	273.5	344.1	288.4
Butterfat, percent	3.37	3.19	3.14	3.19

Reference: U. S. Department of Agriculture Technical Bulletin 724, "Milk and Butterfat Production by Dairy Cows on Four Different Planes of Feeding," pages 2, 3, 4, tables 5 and 9, April 1940.

The Preparation of Corn for Dairy Cows

Conducted by: Iowa Agricultural Experiment Station.

Conducted at: Ames, Iowa.

Period: 1918.

Purpose: To determine the influence of the method of preparation of corn on the production of milk and to compare ear corn, corn-and-cob meal, and corn meal as a feed for dairy cows.

Procedure and conditions: Five young cows in either their first or second lactation were used in this test. They were all in good milking condition, were good feeders and were either open or had been bred but a short time.

The work was divided into five periods of 30 days each. The first 10 days of each period were used as transitions, and in the consideration of the results only the last 20 days of each period are used.

The animals were fed a basal ration of corn silage, clover hay, and a grain mixture of 4 parts wheat bran, 4 parts old-process linseed oil meal, 2 parts cottonseed meal and 1 part of ground oats, by weight. In addition to this they were fed the corn preparation being studied. The silage and hay were fed according to the appetites of the animals, while the total grain ration allowed was determined by the individual production of milk and butterfat. The allowance of the corn preparation was such that corresponding quantities of corn grain dry matter were fed in the various periods and the amount of mixed grain given was equal as nearly as possible to the amount of corn grain dry matter allowed.

The experimental animals were allowed salt at free will and were watered and weighed twice daily. The morning weights, after feeding hay and before watering were used in determining the average liveweights of the animals. Hay, silage, and grain were each fed twice daily. The animals were milked twice daily and the composite sample for each cow was tested for butterfat at the end of each 10-day period.

Table 26. The preparation of corn for dairy cows, Iowa, 1918

	Corn meal vs. ear corn		Corn meal vs. corn-and-cob meal	
	Ear corn	Corn meal	Corn-and-cob meal	Corn meal
Av. liveweight, lbs.	943.0	943.0	961.0	938.0
Corn consumption (14 percent moisture basis):				
Corn, prepared, lbs.	493.0	394.0	309.0	248.0
Corn grain, lbs.	397.0	397.0	247.0	248.0
Feed consumption other than corn:				
Corn silage, lbs.	2,800.0	2,800.0	2,800.0	2,800.0
Clover hay, lbs.	633.0	632.0	492.0	500.0
Mixed grain, lbs.	380.0	380.0	300.0	300.0
Total production:				
Milk, lbs.	1,899.9	2,027.8	1,730.7	1,733.4
Fat, lbs.	85.32	97.35	79.41	80.65
Fat, percent	4.49	4.80	4.59	4.66

Reference: Iowa Agricultural Experiment Station Bulletin 195, "Preparation of Corn for Dairy Cows," pages 300, 301, 302, table 4, Ames, Iowa, January 1921.

Grinding Grains for Dairy Cows

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 84 days, 1933.

Purpose: To determine the effect of grinding grains for dairy cows on the production of milk and weight of cows.

Twenty cows were divided into four lots of five cows each and were fed for a period of 84 actual experimental days on separate grain mixtures containing the proportions and kinds of feed listed in table 27 .

Table 27. Kinds and proportions of concentrates fed, Indiana, 1933

Whole grain ration	Coarsely ground grain ration	Medium ground grain ration	Pulverized grain ration
400 lbs. whole shelled corn 200 lbs. whole oats 200 lbs. wheat bran 100 lbs. linseed oil meal	400 lbs. cracked shelled-corn 200 lbs. crushed oats 200 lbs. wheat bran 100 lbs. linseed oil meal	400 lbs. medium ground shelled corn 200 lbs. medium ground oats 200 lbs. wheat bran 100 lbs. linseed oil meal	400 lbs. pulverized corn 200 lbs. pulverized oats 200 lbs. wheat bran 100 lbs. linseed oil meal

Each cow received approximately 9 pounds of grain daily in addition to 11 pounds of alfalfa hay and 32 pounds of corn silage. The corn and oats furnished two-thirds or 66 percent of the grain ration and supplied approximately 20 percent of the dry matter in the entire ration.

In order to eliminate, to a certain extent, the factor of climatic changes, the four lots of cows were fed according to a definite schedule during each of the feeding periods as shown in table 28.

Table 28. Schedule of feeding, Indiana, 1933.

Lot	Period 1	Period 2	Period 3	Period 4
1	Whole	Medium	Pulverized	Cracked
2	Cracked	Pulverized	Medium	Whole
3	Medium	Whole	Cracked	Pulverized
4	Pulverized	Cracked	Whole	Medium

All grains were ground through one mill of the hammer type using various sized screens for cracked, medium ground, and pulverized grain. In this manner the fineness of grinding remained uniform throughout the trial.

Table 29. Grinding grains for dairy cows, Indiana, 1933.

	Whole grain ration	Coarsely ground grain ration	Medium finely ground grain ration	Pulverized grain ration
Milk production, lbs.	8,975	9,524	10,114	9,564
Fat production, lbs.	200	305	333	302
Grain consumed, lbs.	3,551	3,519	3,463	3,502
Hay consumed, lbs.	4,704	4,703	4,704	4,686
Silage consumed	13,262	13,157	13,267	13,252
Power required for grind	....	4.88 K.W.H.*	13.23 K.W.H.*	136.54 K.W.H.*
Labor of grinding	......	2.14 hrs.	1.65 hrs.	13.08 hrs.
Power per 100 lbs. corn and oats	..	21 K.W.H.*	5.7 K.W.H.*	5.85 K.W.H.*
Labor per 100 lbs. corn and oats	....	.09 hrs.	.07 hrs.	.56 hrs.
Average gain in weight (per 21-day period)	10 lbs.	23 lbs.	22 lbs.	19 lbs.
Milk per 100 lbs. grain feed, lbs.	253	271	292	273

*K.W.H. refers to kilowatt hours of electricity consumed. In order to change this to horse power hours the K.W.H. should be multiplied by the factor .746.

Reference: Indiana Agricultural Experiment Station Bulletin 372, "Grinding Grains for Dairy Cows," pages 2, 3, and 7, tables 1, 2, 3, and 4, Lafayette, Indiana, March 1933.

Mineral Feeds

Milk contains a relatively high percentage of minerals when compared with other types of food. Some feeds commonly used in the dairy cow's ration do not contain sufficient quantities of the minerals needed in the rations for normal health, production and reproduction. It is important, therefore, that minerals be supplied from other sources which will enable the dairy cow to produce the maximum amount of milk. Information is presented below dealing with the value of different minerals in a dairy cow's ration.

CALCIUM AND PHOSPHORUS

Calcium and phosphorus requirements. Calcium (lime) and phosphorus requirements may well be considered together for several reasons. A large percentage of the calcium and phosphorus stored in the body is deposited in the bones in the rather constant ratio of about twice as much calcium as phosphorus. Milk and eggs contain considerable quantities of calcium and phosphorus. The animal body can use calcium and phosphorus independently of each other to only a limited extent. The utilization of both calcium and phosphorus is intimately tied up with vitamin D.

An ample supply of vitamin D (or its equivalent in sunshine) is necessary for the proper utilization of the calcium and phosphorus contained in the ration. Disturbances in calcium and phosphorus nutrition in farm animals are shown in a variety of ways, including rickets and like disorders, retarded growth, decreased milk production, reproductive disturbances, and depraved appetite Cattle most frequently suffer from phosphorus deficiency, pigs from calcium deficiency, and poultry from vitamin D deficiency .

The exact calcium and phosphorus requirements of farm animals are not known. In a general way, these requirements are known to vary with the species of animal, the rate of growth, reproductive requirements, and the production of milk or eggs. For cattle it may be assumed that a ration is not likely to be seriously deficient in calcium and phosphorus unless its dry matter contains less than about 0.3 to 0.4 percent calcium and 0.2 to 0.3 percent phosphorus. Even lower levels are adequate in the absence of rapid growth or high milk production. The calcium and phosphorus requirements of pigs are thought to be slightly higher. The requirements for sheep appear to be distinctly lower than for cattle. The minimum requirements for growing chickens are met when the ratio contains about 0.8 percent calcium and 0.5 percent phosphorus. The calcium requirements for egg production are perhaps about twice as high as for growth.

Calcium and phosphorus contents of feed stuffs. It is obvious that feed stuffs should be chosen with some attention to their calcium and phosphorus contents. It is usually most economical (except in the case of poultry) to combine easily available feed stuffs in such a manner as to provide adequate amounts of calcium and phosphorus. It is important, therefore, to know the approximate calcium and phosphorus contents of the more common types of feed stuffs. Table 30 is designed to show the calcium and phosphorus contents of some representative types of feed stuffs.

The phosphorus content of forage crops is subject to considerable variation due to the influence of the stage of maturity and rainfall. The phosphorus content of pastures and hays is highest during the early stages of growth and during seasons having adequate rainfall.

Mineral supplements. Table 31 gives the approximate calcium and phosphorus content of some representative mineral supplements. It will be noted that some of these supplements are sources of calcium or of phosphorus only, while others supply both calcium and phosphorus. All materials used for mineral supplements should be of a grade for animal feeding.

Table 30. The approximate calcium and phosphorus contents of certain common types of feed stuffs, Oregon, 1940.

Material	Calcium	Phosphorus
	Percent	Percent
Roughages		
Alfalfa hay	1.25	.20
Oat-vetch hay	.73	.22
Oat hay	.34	.17
Wild hay (good)	.61	.18
Grass straw (poor)	.15	.10
Pastures and succulents*		
Good mixed pastures	.70 (.14)	.30 (.06)
Poor grass pasture	.14 (.05)	.13 (.04)
Bunch grass (green)	.34	.19
Bunch grass (bleached)	.30	.07
Corn silage	.36 (.10)	.18 (.05)
Pea-vine silage	1.17 (.30)	.18 (.05)
Concentrates		
Corn	.01	.30
Oats	.09	.35
Barley	.05	.37
Wheat	.05	.36
Wheat bran	.10	1.25
Cottonseed meal	.25	1.10
Linseed meal	.38	.75
Peanut meal	.15	.50
Skim milk powder	1.28	1.00
Meat scraps (55 percent protein)	8.70	4.30
Fish meal (65 percent protein)	7.40	3.70
Beet pulp	.50	.07

*Pastures and silages most commonly contain some 20 to 30 percent dry matter; very succulent plants may contain only 10 percent dry matter; the following analyses have been calculated to the dry-matter basis. Analyses in parentheses are calculated to the fresh basis. Since farm animals consume succulent feed stuffs largely for their nutrient (dry matter) content and not for their water content, analyses calculated to the dry basis are more likely to give the layman a correct nutritional picture.

Reference: Oregon Agricultural Experiment Station Circular 136, "Minerals for Farm Animals," pages 5 and 6, table 1, Corvallis, Oregon, November 1940.

Table 31. Approximate calcium and phosphorus contents of certain mineral supplements, Oregon, 1940.

Material	Calcium	Phosphorus
	Percent	Percent
Oyster shells	38	—
High-grade limestone	38	
Calcium carbonate	40	
Bonemeal (variable)	22-33	10-17
Spent bone black (variable)	About like bonemeal	
Do-sodium phosphate		8-9
Tri-calcium phosphate	39	20
Di-calcium phosphate	23	18
Mono-calcium phosphate	16	24

Reference: Oregon Agricultural Experiment Station Circular 136, "Minerals for Farm Animals," page 7, table 2, Corvallis, Oregon, November 1940.

Free-Choice Feeding of Mineral Supplement to Dairy Cattle

Conducted by: Illinois Agricultural Experiment Station.

Conducted at: Urbana, Illinois.

Period: 1924-1927.

Purpose: To determine whether cattle kept under ordinary herd conditions in barn and dry lot would voluntarily supplement their rations with minerals if given an opportunity.

Procedure and conditions: The cows used in this test were of moderate to good productivity, quite a number of them producing from 40 to 60 pounds of milk daily during the early part of the lactation period. They were milked but twice daily. The animals designated as the "heifer group" consisted of the young daughters of cows included in the cow group. The heifers ranged in age from about 6 to 24 months of age. As they came into milk, they were transferred to the cow group.

All the cattle were confined during the entire period covered by the experiments to barns and dry lots.

The ration fed consisted of corn silage, legume hay, and a grain mixture. The hay was a good grade of either alfalfa, soybeans, or red clover. The grain mixture consisted of ground shelled corn, ground oats, wheat bran, and a second protein supplement. Corn gluten feed supplied this second protein supplement from August 1924 to August 1925; from August 1925 to August 1927, soybean oil meal was used; and subsequent to August 1927, linseed oil meal was used. The grain was weighed at each feeding and fed to the milk cows in proportion to their milk production and to the heifers at a rate to induce rapid growth.

The minerals fed these cattle were placed in boxes in their exercising yards. A box with three compartments was kept in the yard for the milk cows and another in the yard for the young stock (heifers). The boxes were protected somewhat from the weather by means of a shed roof and partially inclosed sides.

Beginning in the summer of 1924 a supply of very finely ground limestone was kept in one of the compartments of each feed-box and common salt in another. At the end of each week during the experiment the amount in each compartment was weighed, and if still in good condition for feeding, was returned to the compartment. More was added during the week as needed to insure a continuous supply.

About August 1, 1926, after 2 years of limestone supplement, bonemeal was added in the third compartment of each feed-box. This bonemeal was called "pure raw bone-feeding meal." The manufacturer stated that this product was made from selected fresh bones and was made safe for feeding by treatment with steam at a high temperature. It was nearly free from odor.

From August 2, 1926, to the end of the experiment in November 1927, the limestone and the bonemeal were mixed with common barrel salt at the rate of 4 parts of limestone or bonemeal to 1 part salt.

The feeding of the above supplement was discontinued each year with the arrival of inclement weather, when the cattle were not turned out into the yards, or when the supplements became damp and frozen so that the cattle could not eat them. With the arrival of warm weather, the yard feeding was resumed. During the times when no mineral supplements were fed in the yard, bonemeal and salt were incorporated in the grain mixture to the extent of 1.5 percent each. Salt was supplied in the grain mixture at the rate of 1 percent during the yard feeding of mineral supplements.

Table 32. Mineral supplements for dairy cattle, Illinois, 1924-1927.

	1924 Sept. 8 to Dec. 15	1925 Mar. 16 to Dec. 21	1926* Jan. 4 to Dec. 13	1927 April 4 to Nov. 28
Heifer group:				
Number animals	212	676	491	534
Limestone	14.6	26.7	23.1	13.5
Bonemeal	—	—	8.2	20.9
Salt	205.6	803.4	432.0	166.5
Cow group:				
Number animals	594	1,658	1,456	579
Limestone	7.3	22.3	57.8	21.1
Bonemeal	—	—	149.1	27.0
Salt	126.7	775.2	599.6	346.0

*In 1926 the cow group covers the period April 5 through December 13, the heifer group covers the period January 4 through October 11. Beginning August 9 and continuing throughout the experiment, the limestone and bonemeal were mixed with common salt at the rate of 4 parts limestone or bonemeal to 1 part salt. The amounts of limestone and bonemeal consumed subsequent to August 2, 1926, are given in terms of the mixtures.

Reference: Illinois Agricultural Experiment Station Bulletin 316, "An Experiment in the Free-Choice Feeding of Mineral Supplements to Dairy Cattle," pages 118, 119, 120, 121, 122, 123, and 124, table 1, Urbana, Illinois, December 1928.

The Effect of Feeding Different Amounts of Calcium and Phosphorus Upon the Growth and Development of Dairy Animals

Conducted by: West Virginia Agricultural Experiment Station.

Conducted at: Morgantown, West Virginia.

Period: 1930.

Purpose: To determine the effect upon growing dairy heifers of feeding rations which contained different amounts of calcium and phosphorus.

Procedure and conditions: Thirty-two grade Holstein heifer calves ranging from 2 to 4 weeks in age were divided into four groups of eight calves each. Each group was fed a ration as similar to the other rations in its digestible crude protein and total nutrient content as it was practical to obtain. All were fed according to the Morrison Feeding Standard for dairy heifers. The chief difference between the rations fed was in the calcium and phosphorus content.

Group 1, the check group, as far as could be ascertained before the beginning of the experiment, was fed a normal ration. This ration was selected as typical of those fed under practical farm conditions. Since this ration contained a legume hay as one-half of the roughage and a typical grain mixture which has been fed widely without apparent bad results, it was assumed that its calcium and phosphorus content was sufficient.

Group 2 was fed a ration very much lower in its calcium content but otherwise similar to that of group 1 in its nutritive value. Group 2 was designated as the low calcium group.

Group 3, designated as the low-phosphorus group, was fed a ration similar in its nutritive value as that fed to group 1 with the exception that it was much lower in its phosphorus content.

Group 4 designated as the low-calcium-low-phosphorus group was fed a ration low in both calcium and phosphorus as compared to the ration fed to group 1, but otherwise similar in its nutritive value.

The animals were handled and cared for in the same manner throughout the experiment in order that the rations consumed would constitute the only difference between the four groups.

In order to study the difference between the rations the heifers were weighed and the height at their withers was measured at weekly intervals.

The animals were housed in a well-lighted and ventilated experimental barn. Each animal was kept in an individual pen so that it could be fed separately. The animals were given no exercise except what they were able to obtain in their pens and when they were weighed each week. It was noted that many of them played a great deal in their pens, thus getting considerable exercise.

The heifers were given all the salt they desired once a week.

The rations used throughout the experiment are given in the following table.

The rations numbered from 1 to 4 were fed during the first year of the experiment and were calculated for a normal 6-month-old heifer. Rations 1a to 4a were fed during the second year of the experiment and were fed to groups 1 to 4 respectively. They were calculated for normal 12-month-old heifers.

Table 33. Average daily ration fed during experiment, West Virginia, 1930.

Feed	Ration number							
	1	2	3	4	1a	2a	3a	4a
Alfalfa hay, lbs.	3		3	..	4	..	4	--
Timothy hay, lbs.	3	6	3	6	4	8	4	8
Corn meal, lbs.	1¼	1	.	..	3	2		--
Ground oats, lbs.	1½	1	..	..	3	2	--	--
Linseed oil meal, lbs.	¾	--	--	--	..	--	--	--
Ground soybeans, lbs.	--	1½	.	..	--	1¾	..	--
Polished rice, lbs.	.	--	2	1½	--	--	3	3
Washed bran, lbs.	--	--	1½	2	..	..	½	1
Wheat gluten, lbs.	--	--	¼	½	--	--	½	1
Beet pulp, lbs.	--	--	--	--	--	--	2	1½

Table 34. Average monthly gain in weight and height at withers of animals in the various groups, by periods, West Virginia, 1930.

	Period ending when animals were at age of			
	8 mos.	12 mos.	19 mos.	25 mos.
Av. monthly gain in weight of group 1 (Normal)	27.75	28.93	35.76	31.36
Av. monthly gain in weight of group 2	25.55	37.77	31.35	23.92
Percent of normal group	92.1	97.0	87.6	76.3
Av. monthly gain in weight of group 3	27.45	37.36	32.60	33.93
Percent of normal group	99.0	96.0	91.4	108.2
Av. monthly gain in weight of group 4	24.81	34.94	32.73	17.17
Percent of normal group	89.4	89.7	91.5	54.8
Height at withers:				
Av. monthly gain in height of group 1 (Normal)	3.31	2.45	1.94	1.00
Av. monthly gain in height of group 2	2.83	2.30	1.84	0.74
Percent of normal group	85.5	93.8	94.8	74.0
Av. monthly gain in height of group 3	3.23	2.70	1.74	0.85
Percent of normal group	97.6	110.2	89.5	85.0
Av. monthly gain in height of group 4	2.93	2.27	1.75	0.83
Percent of normal group	88.5	92.6	90.2	83.0

Reference: West Virginia Agricultural Experiment Station Bulletin 231, "The Effect of Feeding Different Amounts of Calcium and Phosphorus Upon the Growth and Development of Dairy Animals," pages 5, 6, 8, 10, 17, and 19, tables 3, 8, and 9, Morgantown, West Virginia, March 1930.

Feeding Bonemeal to Dairy Cows

Conducted by: Pennsylvania Agricultural Experiment Station.

Conducted at: State College, Pennsylvania.

Period: December 1930 to July 1938.

Purpose: To compare the feeding of a basal ration containing farm feeds to the same ration plus a liberal allowance of bonemeal to dairy cows.

Procedure and conditions: Records were completed on 33 cows, high grade Holsteins, with a total of 117 lactations. The two rations used were as nearly identical as possible at all times except 2 percent of bonemeal was added to the concentrate mixture fed to the cows receiving the so-called bonemeal ration. All cows were on good pasture, usually fertilized, during the summer months. During the remainder of the year the cows were housed in a modern barn.

Daily records were kept of the amounts of feed consumed and of milk produced by each individual cow, the number of services necessary for conception, the sex of the calves, the health of the cows, and other changes or developments that might result from the experimental ration fed. The cows were weighed each month during most of the experiment, and blood samples were analyzed on several occasions for calcium and inorganic phosphorus. One-day composite samples of milk were taken at approximate monthly intervals for butterfat tests.

As the cows became old, went out of production, and were sold, heifers were introduced into the herd at first calving, and records on some of these young cows were obtained for only one lactation before the experiment closed. A recurrent outbreak of abortion, which started early in the test period, was followed by all of the difficulties usually associated with this disease and made record keeping difficult.

Because excess minerals in the originally planned experimental ration apparently caused overly-large calves and difficulty on the part of some of the cows in calving, certain feeds were dropped from the experiment along with the cows which had experienced this kind of trouble. The roughages fed consisted of timothy hay, usually an early cutting and of high grade, and corn silage. It was necessary to change the concentrate mixture from year to year, because certain ingredients were more economical or more easily obtained during some seasons than others. In general, the concentrate mixtures contained about 18 percent protein. The rate of grain feeding was regulated according to milk production.

During the first part of the experiment, the cows were fed one ration for several lactations. Later, the plan was changed and the bonemeal and no-bonemeal rations were alternated each year. The rations were reversed on the day after the cows were turned dry, the ration for the dry period being the same as the ration for the following lactation period. Twenty-three of the cows finished complete lactations on both rations.

Table 35. A representative grain mixture such as was fed to cows when on the basal ration. Two percent of bonemeal was added to make up the bonemeal ration, Pennsylvania, 1930-38.

Ingredients	Pounds	Ingredients	Pounds
Corn and cob meal	200	Dried brewers' grains	125
Banner oat feed	100	Wheat bran	100
Barley feed	100	Cottonseed meal	25
Hominy feed	100	Salt	9
Diamond gluten meal	200	(Plus 2 percent bonemeal in bonemeal ration)	

Table 36. Bonemeal versus no bonemeal for dairy cows in Pennsylvania, 1930-1938.

Average per cow	Basal ration	Basal ration plus bonemeal
Number of cows	23	23
Number of lactations	57	43
Lactations period	261	272
Calving interval	363.3	373.4
Dry period before lactation	87.5	92.2
Milk production:		
Average per cow	8,654.0	9,008.0
Average per cow per day	33.2	33.2

Reference: Pennsylvania Agricultural Experiment Station Bulletin 395, "Bonemeal versus No Bonemeal in the Dairy Ration," pages 1, 2, and 3, table 3, State College, Pennsylvania, April 1940.

Roughages for Dairy Cows

Roughages may be classified into two groups, dry and succulent, both of which have an important place in the feeding of dairy cattle. The feed-utilization capacity of dairy cattle is such that they can consume large quantities of roughage feeds, and roughages are relatively cheap when compared to other types of feed. In planning the feeding program to use, the maximum amount of this type of feed consistent with adequate nutrition, should be provided. In doing so, the cost of feeding should be materially affected. On a per ton basis the cost of hay or silage is much smaller than on grain and in many cases the actual feeding value, depending on the quality, of course, is not a great deal less than grain. It should be pointed out that the amount of roughage feed provided will have a direct bearing on the amount of some of the high protein feeds that can be used in a ration. This is especially true with cottonseed meal. Experimental results show that large quantities of cottonseed meal can be used without injurious effect provided sufficient quantities of high quality roughages are included in the ration.

Experimental information shown below should be examined carefully and plans made to provide a maximum amount of hay and silage to be used in the feeding of dairy cattle under Mississippi conditions.

A Comparison of Legume and Grass Hays When Fed in Combination With Concentrates for Three Sources at State College, Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1932-1933.

Purpose: To determine the comparative value of soybean and Johnson grass hay in milk production.

Procedure and conditions: Three lots of four cows each were used in this experiment. Soybean hay was used as the legume and Johnson grass as the grass hay. The reversal system of feeding was adopted. A grain ration consisting of 100 pounds of cottonseed meal, 100 pounds of wheat bran, and 100 pounds of corn chops was fed at the rate of approximately 1 pound to each 4 pounds of milk produced. In addition, the cows in all the lots each received 20 pounds of sorghum silage and ½ pound of blackstrap molasses daily. Lot 1 received Johnson grass hay during the first and third periods and soybean hay the second period. Lot 3 received Johnson grass hay throughout the three periods. Only the last 3 weeks of each period was used in making the comparison. The hay for all lots was fed ad libitum for the purpose of determining the greatest amount of each of the hays the cows would consume. A careful check was made of the amount actually eaten by each lot.

Table 37. Comparative values of soybean hay and Johnson grass hay in milk production, Mississippi, 1932-1933.

(Figures given as averages per cow)	Lot 1 Johnson gras hay av. of 3 periods Reversal	Lot 2 Soybean hay av. of 3 periods Reversal	Lot 3 Johnson grass hay av. of 3 periods Straight
Number of cows	4	4	4
Av. gain or loss in liveweight, lbs.	36.5	—15.7	32.7
Av. production per day:			
Milk, lbs.	13.3	13.4	14.1
Fat, lbs.	.68	.67	.65
Feed in pounds:			
Mixed feed consumed per day	4.8	4.8	4.8
Molasses consumed per day	.5	.5	.5
Hay fed per day	18.7	18.7	18.7
Hay refused per day	3.3	5.1	4.8
Hay eaten per day	15.4	13.6	13.9
Silage fed per day	20.0	20.0	20.0

Reference: Mimeographed tables for departmental use. Unpublished data from Dairy Department, Mississippi State College, State College, Mississippi.

Comparison of Legume Hays for Dairy Cows, State College, Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1922-1923.

Purpose: To compare some common legume hays in the production of milk.

Procedure and conditions: In selecting the cows that were to be used in the test, attention to ability for milk production, percent of fat in milk, weight of cows, and length of lactation period were considered. The reversal method of feeding was followed.

Soybean hay versus alfalfa hay. There were five cows (three Jerseys, two Ayrshires) in the lot; and they were fed for three 30-day periods, the first 10 days of each period being allowed for changing feeds, and the last 20 days only of the period being used in the experiment proper. Alfalfa hay was fed during the first and third periods and soybean hay was fed the second period, The basal grain ration consisted of 50 percent corn chops, 25 percent wheat bran, and 25 percent cottonseed meal by weight. In addition to the hay and grain, the cows received corn silage.

While the cows were on the alfalfa hay ration, they ate 88.24 percent of the alfalfa given. When on the soybean hay ration, they ate 83.15 percent of the soybean hay.

Soybean hay versus lespedeza hay. In making this test, five cows were used (two Ayrshires and three Jerseys). The periods were the same as for the test with alfalfa, the first 10 days of each period being used as a transition period and the last 20 days for the test proper. The grain in this test consisted of a mixture containing 300 pounds cottonseed meal, 200 pounds wheat bran, 100 pounds hominy feed, 100 pounds rice bran, and 100 pounds rice polish. In addition to, and included in, the grain ration, each cow received 3 pounds per day of blackstrap molasses.

Three of the five cows lost weight while getting lespedeza hay and one cow gained weight on the soybean hay. The hay refused during the soybean period was 18.84 percent greater than when the cows were fed lespedeza hay.

Table 38. Comparison of legume hays for dairy cows, State College, Mississippi, 1922-1923.

	Soybean versus alfalfa hay		Soybean versus lespedeza hay	
	Period 2 Soybean	Periods 1 and 3 Alfalfa	Period 2 Lespedeza	Periods 1 and 3 Soybean
Number of cows	5	5	5	5
Av. gain or loss in liveweight, lbs.	—20	7	—0.4	—29
Production per cow:				
Milk in pounds	348.0	351.2	487.0	509.0
Fat percent	3.98	3.70	3.92	3.93
Fat in pounds	13.84	13.00	19.09	19.99
Feed consumed per cow:				
Hay in pounds	216.0	216.0	256.0	256.0
Silage in pounds	440.0	440.0	400.0	400.0
Grain in pounds	102.0	102.0	260.0	236.0
Feed consumed per 100 lbs. milk:				
Hay in pounds	39.4	39.2	52.5	50.3
Silage in pounds	80.3	79.8	82.1	78.6
Grain in pounds	18.6	18.5	48.5	46.4

Reference: Mississippi Agricultural Experiment Station Bulletin 235, "Soybeans for Dairy Cows," pages 4, 6, and 7, tables 2, 3, 4, 5, 6, and 7, State College, Mississippi, June 1926.

A Comparison of Cottonseed Hulls and Grass Hays for Milk Production

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Test 1—Southwestern Louisiana Institute, Lafayette, Louisiana.
Test 2—North Louisiana Experiment Station, Calhoun, Louisiana.
Test 3—Baton Rouge, Louisiana.

Period: Winter 1932-33.

Purpose: To compare the feeding value of cottonseed hulls with (1) Bermuda grass hay, (2) grass hay, and (3) mixed hay for milk production.

Procedure and conditions: Two groups of four cows each were used in each test and fed by the single reversal method with a 10-day preliminary feed adjustment period in all cases. In tests 1 and 2, Jersey cows were used for a period of 50 days each, milked twice daily but not weighed. In test 3, Holstein cows were fed for net periods of 35 days, milked three times daily and weighed for 3 successive days at beginning and end of each period. In this experiment, test 1 was started in late October; test 2, November 1; and test 3, December 1.

In the first two tests, a grain ration containing 40 parts choice cottonseed meal, 60 parts corn- and cob-meal (in test 1, 20 parts wheat bran was substituted for one-third of the corn), 2 parts oystershell flour was fed (1½ parts each of oystershell flour, bonemeal and salt in test 2) and 1 part salt was fed to both groups of cows. In test 3, a ration consisting of 20 parts each of cottonseed meal, ground oats, wheat bran, 40 parts hominy feed and 1 part salt was fed with the mixed hay, while the cows on cottonseed hulls received grain with 40 parts cottonseed meal, 20 parts each of ground oats, wheat bran, and hominy feed with 2 parts oystershell flour and one part salt. This gave a comparable protein content to the total ration. Corn silage, sorgo silage, and corn and soybean silage respectively, were fed at about three pounds per 100 pounds liveweight. Cottonseed hulls were fed at the same rate as hay consumed in the first two tests. Consumption was light because of unpalatability of the latter. In test 3, hay and hulls were fed at the rate of 1 pound daily per 100 pounds liveweight. Three pounds daily of cane molasses diluted with an equal amount of water were poured over the roughage to induce complete consumption. In only one case, for 2 days were the cottonseed hulls refused. In all tests, both groups had access to the same winter pasture. Because of severity of weather this was almost a negligible amount except in test 1 where some grass was available and test 2 with rye and barley pasture.

Table 39. Comparison of cottonseed hulls, Bermuda grass hay, grass hay and mixed hay for milk production in Louisiana, 1932-1933.

	Test 1 Lafayette, La.		Test 2 Calhoun, La.		Test 3 Baton Rouge, La.	
	C. S. hulls group	Bermuda group	C. S. hulls group	Grass hay group	C. S. hulls group	Mixed hay group
Number of cows	4	4	4	4	4	4
Production per cow:						
Milk	883	939	958	911	1,374	1,519
Fat, percent	5.19	4.93	5.57	5.36	4.19	4.01
Fat, lbs.	45.8	46.3	53.5	47.6	57.6	60.9
Total feed consumption per cow:						
Grain, lbs.	373	356	404	419	459	475
Hay, lbs.	...	350	...	335		367
Hulls, lbs.	350		362		362	...
Silage, lbs.	1,197	1,197	1,670	1,670	1,117	1,102

Reference: Louisiana Agricultural Experiment Station Bulletin 238, "A Comparison of Cottonseed Hulls and Grass Hays for Milk Production," pages 1, 2, 3, 4, 5, and 6, table 2, Baton Rouge, Louisiana, July 1933.

Corn Silage versus Sweet Sorghum Silage for Milk Production

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: 1925-26, 1926-27, and 1927-28.

Purpose: To compare corn silage with sorghum silage as a feed for dairy cows.

Procedure and conditions: This data covers the work of three separate trials performed with conditions as nearly identical as possible. In all, 30 animals were used and were grouped as follows for the individual years: 1925-26, twelve cows divided into two lots of six animals each; 1926-27, eight cows divided into two lots of four animals each; 1927-28, ten cows divided into two lots of five animals each. Each year the two lots were made as similar as possible basing the selection upon breed, weight, age, stage of gestation, stage of lactation, daily milk production, and butterfat percentage.

In the first trial the entire experiment covered a period of 114 days, divided into three 30-day experimental periods, each of which was preceded by a 10-day preliminary or 7-day transitional period. During the second and third trials the transitional periods and preliminary periods were each 10 days in length, thus extending the entire trial over a period of 120 days.

A basal ration as follows was fed to each group of cows throughout the entire experiment:

Oat and vetch hay
Grain mixture:
  Corn meal, 300 pounds
  Ground oats, 200 pounds
  Wheat bran, 100 pounds
  Cottonseed meal, 200 pounds
  Salt, 1 pound to each 100 pounds of the above mixture

To this basal ration was added corn or sorghum silage, depending upon which experimental period a lot was in. When corn silage was included, the ration was designated as the corn silage ration; when sorghum silage was included the ration was designated as the sorghum silage ration. These terms are used throughout the test of this experiment.

The 30-day experimental periods were each divided into three 10-day periods for convenience in keeping the necessary data. The daily ration for each animal was computed every 10 days, basing the computation upon the average daily production and average weight of the cow for the preceding 10-day period. Each animal was weighed the last three days of each 10-day period, the average of these weights being taken as an index weight, a figure upon which to compute the feed requirement for the following 10-day period. Each weighing was made at approximately the same time of day.

The cows were milked twice daily and the weight of milk recorded after each milking. Composite milk samples were taken for each animal. These samples were tested by the Babcock method at the end of each 10-day period.

All feed fed to and refused by the animals was weighed daily. Silage and grain was fed twice daily, previous to milking; hay was fed at one feeding, immediately after the evening milking. The animals were stanchioned in individual stalls with specially constructed mangers designed to eliminate wasting of feed and stealing from each other. Water was accessible in a pasture lot where the experimental cows were pastured with the regular Station milking herd. Care was taken to exclude green forage from the ration by placing the animals in a dry lot when it was thought that the spring pasture herbage was such as to influence the feeding conditions.

Table 40. Corn silage versus sorghum silage for milk production, South Carolina, 1925-1926 to 1927-1928.

	Corn silage ration	Sorghum silage ration
Total feed consumed:		
Hay, lbs.	8,427.22	8,529.36
Silage, lbs.	35,446.77	36,223.42
Grain, lbs.	6,623.76	8,603.21
Total milk produced, lbs.	22,784.90	22,362.80
Butterfat:		
Pounds	829.879	824.965
Percent	3.642	3.645
Change in body weight:		
Av. both lots on corn silage, gain	133.5	....
Av. both lots on sorghum silage, gain		277.0

Reference: South Carolina Agricultural Experiment Station Bulletin 254, "Corn Silage versus Sweet Sorghum Silage for Milk Production," pages 6, 7, 8, 20, 21, and 22, tables 23, 24, and 25, Clemson, South Carolina, January 1929.

Unground versus Ground Oats and Vetch Hay for Dairy Cows

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: 1927-1928.

Purpose: To compare the value of ground and unground oats and vetch hay for dairy cows.

Procedure and conditions: Ten cows divided into two lots of five animals each were selected from the Experiment Station dairy herd. The two lots were made as similar as possible, the selection being based upon breed, age, stage of lactation, stage of gestation, daily milk production, and butterfat percentage.

The entire experiment covered a period of 120 days divided into three 30-day experimental periods, each of which was preceded by a 10-day preliminary or transitional period. The following grain mixture was used: 350 pounds of corn-and-cob meal, 200 pounds of ground oats, 200 pounds of wheat bran, 250 pounds of cottonseed meal, and 100 pounds of corn gluten feed. To the basal ration there was added unground or ground hay, depending upon which experimental period a lot was in. When unground hay was included, the ration was designated as the unground hay ration, when ground hay was included, the ration was designated as the ground hay ration.

The cows were milked twice daily and the weight of milk was recorded after each milking. All feed fed to and refused by the animals was weighed daily. Silage and grain were fed twice daily, immediately preceding milking; hay was fed once per day, following the evening milking. The animals were fed in stanchions, specially constructed manger attachments being used to avoid loss of feed and to prevent stealing of feed from each other.

Table 41. Unground versus ground oats and vetch hay for dairy cows, South Carolina, 1927-1928.

	Unground hay	Ground hay
Feed consumed per cow per day:		
Hay, lbs.	7.76	9.87
Silage, lbs.	29.26	29.27
Grain, lbs.	8.24	7.42
Milk produced, lbs.	21.05	21.07
Butterfat produced:		
Pounds	.959	.965
Percent	4.56	4.58

Reference: South Carolina Agricultural Experiment Station Bulletin 255, "Ground Hay for Milk Production," pages 8, 10, and 21, table 15, Clemson, South Carolina, January 1929.

Unground versus Ground Soybean Hay for Dairy Cows

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: 1926-1927.

Purpose: To compare the value of ground and unground soybean hay as a feed for dairy cows.

Procedure and conditions: Eight cows divided into two lots of four animals each were selected from the Experiment Station dairy herd. The two lots were made as similar as possible, the selection being based upon breed, weight, age, stage of lactation, stage of gestation, daily milk production, and butterfat percentage.

The entire experiment covered a period of 120 days divided into three 30-day experimental periods, each of which was preceded by a 10-day preliminary or transitional period. The following grain mixture was used: 350 pounds of corn-and-cob meal, 200 pounds of ground oats, 200 pounds of wheat bran, 250 pounds of cottonseed meal, and 100 pounds of corn gluten feed. To the basal ration there was added unground or ground hay, depending upon which experimental period a lot was in. When unground hay was included, the ration was designated as the unground hay ration; when ground hay was included, the ration was designated as the ground hay ration.

The cows were milked twice daily and the weight of milk was recorded after each milking. All feed fed to and refused by the animals was weighed daily. Silage and grain were fed twice daily, immediately preceding milking; hay was fed once per day, following the evening milking. The animals were fed in stanchions, specially constructed manger attachments being used to avoid loss of feed and to prevent stealing of feed from each other.

Table 42. Unground versus ground soybean hay for dairy cows, South Carolina, 1926-1927.

	Unground hay	Ground hay
Feed consumed per cow per day:		
Hay, lbs.	9.98	10.84
Silage, lbs.	29.78	29.16
Grain, lbs.	6.49	6.24
Milk produced, lbs.	23.34	23.56
Butterfat produced:		
Pounds	.966	.976
Percent	4.14	4.14

Reference: South Carolina Agricultural Experiment Station Bulletin 255, "Ground Hay for Milk Production," pages 9, 10, and 15, Clemson, South Carolina, January 1929.

Unground versus Ground Alfalfa Hay for Milk Production

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: 1926.

Purpose: To compare the value of ground and unground alfalfa hay as a feed for dairy cows.

Procedure and conditions: Ten cows divided into two lots of five animals each were selected from the Experiment Station dairy herd. The two lots were made as similar as possible, the selection being based upon breed, weight, age, stage of lactation, stage of gestation, daily milk production, and butterfat percentage.

The entire experiment covered a period of 120 days divided into three 30-day experimental periods, each of which was preceded by a 10-day preliminary or transitional period. This arrangement allows for the comparison within a lot of the average of the first and third experimental periods with the second experimental period and also permits one lot to be used as a check against the other. Differences resulting from seasonal variations and variations due to advancing stages of lactation and gestation are minimized.

During the trial the following grain mixture was used: 350 pounds of corn-and-cob meal, 200 pounds of ground oats, 200 pounds of wheat bran, 250 pounds of cottonseed meal, and 100 pounds of corn gluten feed.

To the basal ration there was added unground or ground hay, depending upon which experimental period a lot was in. When unground hay was included, the ration was designated as the unground hay ration; when ground hay was included, the ration was designated as the ground hay ration.

The animals were allowed all the dry roughage they would consume, at the same time making the ration approximate conditions which might prevail on the dairy farms where good feeding practices were followed. The corn silage was fed at the rate of approximately three pounds to each 100 pounds of liveweight. The grain mixture was fed in proportion to production, using the Henry and Morrison Feeding Standard for computing feed requirements.

The 30-day experimental periods were subdivided into three 10-day periods for convenience in recording the necessary data. The daily ration for each animal was computed every 10 days, basing the computation upon the average daily milk production and average weight of the cow for the preceding 10-day period, the average of these weights being taken as an index weight. Weighings were made at the same time of day to avoid variations due to the difference in the feed and water content of the digestive tract.

The cows were milked twice daily and the weight of the milk was recorded after each milking.

All feed fed to and refused by the animals was weighed daily. Silage and grain were fed twice daily, immediately preceding milking; hay was fed once per day, following the evening milking. The animals were fed in stanchions, specially constructed manger attachments being used to avoid loss of feed and to prevent stealing of feed from each other.

Table 43. Unground versus ground alfalfa hay for milk production, South Carolina, 1926.

	Unground hay	Ground hay
Feed consumed per cow per day:		
Hay, lbs.	15.02	14.91
Silage, lbs.	30.92	30.84
Grain, lbs.	4.49	4.86
Milk produced per cow, lbs.	26.10	26.47
Butterfat produced:		
Pounds	.957	.999
Percent	3.66	3.77

Reference: South Carolina Agricultural Experiment Station Bulletin 255, "Ground Hay for Milk Production," pages 9, 10, and 13, table 4, Clemson, South Carolina, January 1929.

Peanut and Soybean Hay for Milk Production in North Carolina

Conducted by: North Carolina Agricultural Experiment Station.

Conducted at: Raleigh, North Carolina.

Period: 115 days, divided into three 30-day periods, preceded by 5-day preliminary feeding periods, 1934-36.

Purpose: To compare peanut hay and soybean hay as feeds for dairy cows.

Procedure and conditions: This experiment covers a 3-year period. Three 30-day feeding periods each year with 5-day preliminary feeding periods before each 30-day period.

Arrangements of feeding periods, North Carolina, 1934-1936.

Lot no.	5 days	30 days, first feeding trial	5 days	30 days, second feeding trial	5 days	30 days, third feeding trial
1	Preliminary	Soybean hay	Transitional	Peanut hay	Transitional	Soybean hay
2	Preliminary	Peanut hay	Transitional	Soybean hay	Transitional	Peanut hay

This arrangement, the double reversal method, makes possible the comparison within a lot of the first and third experimental periods and also allows for one lot to be used as a check against the other lot. The plan equalizes the difference resulting from seasonal changes and variation due to advancing stages of lactation and gestation.

A basal ration as follows was fed to each group of cows throughout the entire experiment:

Beet pulp
Grain mixture: 400 pounds corn meal
300 pounds cottonseed meal
200 pounds wheat bran
100 pounds ground oats

The corn used in this mixture was No. 2 yellow, purchased in the central market, Cincinnati, Ohio. The cottonseed meal was prime meal purchased locally. The bran was standard wheat bran purchased from the central market, Cincinnati, Ohio; and the oats were purchased from Eastern North Carolina.

To this basal ration was added peanut hay (Jumbo or large Virginia variety) or soybean hay (Laredo variety), depending upon which experimental period a lot was in. When peanut hay was included, the ration was designated as the peanut ration; when soybean hay was included, the ration was designated as the soybean ration. These terms are used throughout.

All feed fed to the animals was weighed daily. The animals were stanchioned in individual stalls with specially constructed experimental mangers designed to eliminate wasting of feed and stealing from each other. Water was accessible at all times in individual drinking cups and in a tank in the dry lot where the animals were turned each day for several hours for exercise when the weather permitted. Care was taken to exclude all green forage from the animals which might affect the feeding conditions.

Table 44. Feeding peanut and soybean hay to dairy cows, average 3 trials, nine 30-day periods, North Carolina, 1934-1936.

	Peanut hay group	Soybean hay group
Number of cows:		
First trial	5	5
Second trial	4	4
Third trial	5	5
Daily production per cow:		
Milk, lbs.	26.51	23.88
Butterfat, lbs.	1.08	1.02
Daily feed consumption per cow:		
Grain, lbs.	9.44	9.56
Beet pulp, lbs.	4.78	4.77
Hay, lbs.	13.80	13.76
Feed consumed per 100 lbs. milk:		
Grain, lbs.	35.63	40.03
Beet pulp, lbs.	18.06	19.99
Hay, lbs.	52.07	57.64
Gain or loss in weight per cow	35.40	—10.43

Reference: North Carolina Agricultural Experiment Station Bulletin 312, "The Comparative Values of Peanut and Soybean Hay for Milk Production," pages 7, 8, 21, and 22, Raleigh, North Carolina, August 1937.

Feeding Alfalfa Hay Alone and With Concentrates

Conducted by: Oregon Agricultural Experiment Station.

Conducted at: Umatilla Field Station, Hermiston, Oregon.

Period: 1933 to 1937, including four lactation periods.

Purpose: To compare the feeding of alfalfa hay alone with the feeding of alfalfa hay plus concentrates to dairy cows.

Procedure and conditions: During the first two lactation years, 1933-34 and 1934-35, one group of cows was fed a ration consisting exclusively of alfalfa hay, and a second group was fed a limited grain ration in addition to the alfalfa hay. During the third and fourth lactation years, 1935-36 and 1936-37, animals in both groups had access to limited pasture. Since the entire herd freshened in the fall and early winter the majority of the cows were in the fifth lactation month at the time of going on pasture. In addition, all cows had free access to stock salt, di-sodium phosphate, and steamed bonemeal, records being kept of the amount of each consumed by each group. All cows were kept continuously in the same group during the entire 4 years, if they remained in the herd that long.

The various lactation years will hereafter be referred to as first, second, third and fourth, rather than by the calendar dates.

The original stock used for the herd was a number of yearling heifers purchased from farmers on the Umatilla project, largely grade Jerseys, and were thought to have about the same productive capacity as the average animal on the project. The animals added to the herd since have been the daughters of the original stock sired by unproved, registered Jersey bulls.

During the first year of this experiment the herd consisted of 11 grade Jerseys and 3 grade Guernseys, which were divided into 2 groups, 7 fed hay and grain, and 7 hay alone. All but 3 of these animals were immature, although 10 of them had previous records.

An attempt was made to place animals of approximately the same actual or potentional productive ability in each group.

For the second year 2 animals were removed from the herd because of garget and low production; and 8 heifers, progeny of the original cows, were added so that each group consisted of 10 animals.

In the third year 5 low producers from the second year's experiment were eliminated and 9 heifers added, so that 11 cows were in the grain group and 13 in the hay group. At the conclusion of the third year 1 cow died and 9 were sold, 8 for low production and 1 as a non-breeder. Nine heifers were added.

For the fourth year the herd consisted of 12 cows receiving hay only, and 11 receiving grain. Heifers that were added to each group for each year were balanced according to production of their dams as nearly as possible. Full sisters were placed in opposite groups.

During the entire period of the experiment the cows were handled in much the same manner as the majority of the dairy animals in eastern Oregon. The cows were given all the hay they would consume without waste, and records were kept of the amount consumed by groups. The same quality of unchopped hay was fed to each group, and when any hay was refused, it was weighed back.

The concentrate mixture consisted of four parts mill run, two parts ground barley, and one part ground oats. This was fed at the time of milking according to the amount of butterfat produced. During the first 2 years, 1 pound of grain was allowed per day for each pound of fat produced in 5 days. For the third and fourth years of the experiment the grain-feeding level was changed so that 1 pound of grain was fed for each 1/10 pound of butterfat above a minimum level of 0.7 pound of butterfat daily. Under this plan high-producing cows received more grain during peak production than during the first 2 years of the experiment, and low-producing cows received less. Concentrates fed at these rates would be considered a limited grain ration, averaging during the 4 years approximately 1 pound of grain to 4 pounds of milk.

Dry cows were allowed pasture during the summer, and the rest of the season were fed hay with some succulent feed such as squash or roots when available. No grain was fed to dry animals.

Table 45. Feeding dairy cows with and without concentrates, Hermiston, Oregon, 1933-1937.

	Hay group	Concentrate group
Number cows	11	10
Lactation period (days)	301.00	302.00
Production:		
Milk, lbs.	4,192.00	5,358.00
Butterfat, percent	5.68	6.48
Butterfat, lbs.	238.30	294.00
Feed per pound fat:		
Hay, lbs.	36.70	27.90
Concentrates, lbs.	----	3.60

Reference: Oregon Agricultural Experiment Station Bulletin 380, "Feeding Alfalfa Hay Alone and With Concentrates to Dairy Cows," pages 6, 7, and 9, tables 2 and 3, Corvallis, Oregon.

Feeding Various Legume Hays for Milk Production, Virginia

Conducted by: Virginia Agricultural Experiment Station.
Conducted at: Blacksburg, Virginia.
Period: 1935-36.

Purpose: To compare the value of Korean lespedeza sericea and alfalfa hay for milk production.

Procedure and conditions: Nine cows were used in these trials in 1935 and six in 1936. Each year these cows were divided into three groups making three cows per group in 1935 and two in 1936. The groups were fed an average of 29½ days on each hay and grain ration in 1935, an average of 20 days in 1936. After each period each group was changed to the next hay so that at the end of the trials all of the cows had been fed for one period on each day. This method of alternating or reversing groups lessens the errors due to differences in the animals. In 1935 one cow had to be taken off the test in the last period; therefore, the results from the other groups were reduced by one-third in the last period to make a fair comparison.

Table 46. Milk production from different legume hays, average 2 years, Virginia, 1935-1936.

	Korean lespedeza	Lespedeza sericea	Alfalfa
Number of cow days on test	178	178	178
Quality of hay:			
1935	medium	medium	medium
1936	good	good	good
Hay fed, lbs.	3,072	3,079	3,136
Grain fed, lbs.	1,586	1,586	1,586
4 percent milk produced, lbs.	4,244	4,269	4,864

Reference: Virginia Agricultural Experiment Station Bulletin 305, "Korean Lespedeza and Lespedeza Sericea Hays for Producing Milk," pages 4, 6, and 7, table 4, Blacksburg, Virginia, September 1936.

Ground versus Unground Soybean Hay for Dairy Cows

Conducted by: Maryland Agricultural Experiment Station.

Conducted at: College Park, Maryland.

Period: 90 days, January 1, to March 25, 1928.

Purpose: To determine the effects of grinding soybean hay for dairy cows.

Procedure and conditions: Two groups of six cows each were selected from the Experiment Station herd for this experiment. In the choice of cows only such were used as were expected to continue milk well beyond the close of the feeding trial.

Although all the cows were on Advanced Registry tests they were kept with the remainder of the herd, milked but twice per day by a Delaval milking machine, and the weights of milk recorded. Samples of milk were taken from each cow regularly one night and morning each week for the purpose of determining the percentage of butterfat it contained.

Group 1 was composed of three Ayrshire and three Guernsey cows, and group 2 of one Jersey, three Ayrshire, and two Guernsey cows.

The double reversal method of feeding was used. The test ran 90 days and was divided into 3 periods of 30 days each. The first 5 days of each period were regarded as preliminary, and the data collected during those days were not used in computing results.

Group 1 received ground soybean hay for the first 30-day period, was then changed to the unground hay for the second 30-day period, and returned to the ground hay the third 30-day period. Group 2 was fed unground soybean hay the first 30-day period, then changed to the ground for 30 days and returned to the unground hay the third period.

The cows were fed soybean hay at the rate of 1 pound for each hundred pounds of liveweight. Silage was fed throughout the trial at the rate of 3 pounds daily for each hundred pounds of liveweight. The hay and silage were fed twice daily, equal amounts being fed morning and evening. The quantity of hay and silage fed was not increased or decreased with a change in liveweight; a constant amount of hay and silage based on the initial weights of the cows, was fed throughout the trial.

A concentrate mixture consisting of 600 pounds ground corn, 500 pounds wheat bran, 400 pounds ground oats, 200 pounds linseed meal, 200 pounds peanut meal, 200 pounds gluten meal, and 20 pounds salt was fed throughout the trial. The cows were fed all the grain they would clean up. The grain fed amounted to 1 pound for each 2½ to 3 pounds of milk produced. The grain was fed morning and evening on silage before milking.

After the grain and silage were cleaned up, the mangers and feeding alley were swept before the hay was fed. Hay was weighed morning and evening on a 60-pound milk scale. Before grain and silage were again fed, the refused hay was swept up and weighed. In this way the amount of hay fed and the amount refused was weighed and recorded morning and evening. The soybean hay was of good quality, leafy, cut after the pods were well filled but before the seed were mature. A large part of the stalk was so coarse that the cows would not eat it when fed in the unground state.

Throughout the test each animal was weighed weekly on the same day and at the same hour.

Table 47. Summary results of milk yield and butterfat production for groups 1 and 2, Maryland, 1928.

	Pounds milk	Percent fat	Pounds fat
Group 1			
1st 25-day period, fed ground hay	3,674.5	4.118	151.318
2nd 25-day period, fed unground hay	3,405.4	3.989	135.833
3rd 25-day period, fed ground hay	3,243.0	4.326	140.294
Average, 1st and 3rd periods, ground hay	3,458.7	4.216	145.804
2nd period, fed unground hay	3,405.4	3.989	135.833
Difference in favor of ground hay	53.3	.277	9.971
Percent in favor of ground hay	1.562	5.690	7.341
Group 2			
1st 25-day period, unground hay	3,962.1	4.789	189.756
2nd 25-day period, ground hay	3,954.1	4.922	194.640
3rd 25-day period, unground hay	3,861.1	4.870	188.046
2nd 25-day period, ground hay	3,954.1	4.922	194.640
Average 1st and 3rd unground hay	3,911.4	4.829	188.901
Differcene in favor of ground hay	42.7	.093	5.739
Percent in favor of ground hay	1.091	1.925	3.038
Combined results for the two tests			
Differcent in favor of ground, group 1	53.3	.227	9.971
Difference in favor of ground, group 2	42.7	.093	5.739
Total increase	95.9	.155*	15.710
Percent increase	1.311	3.492	4.838

*Weighted average increase in percent fat.

Reference: Maryland Agricultural Experiment Station Bulletin 316, "Ground versus Unground Soybean Hay for Dairy Cows," pages 1, 2, and 3, table 3, College Park, Maryland, October 1929.

Feeding Ground Roughage to Dairy Cows
Part I

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Purpose: To determine the effect of grinding roughage for dairy cows.

Period: March 1 to May 31, 1928.

Procedure and conditions: Twelve cows, six Holsteins and six Jerseys, were used in this project. They were divided into two groups of six cows each and were as nearly equal in production and other factors as could be arranged with the animals available. The reversal system of feeding was used. The rations fed four of the cows in each group were reversed on February 1. The rations fed the two remaining cows in each group were not reversed until March 15, because they calved after the first feeding period began.

The rations consisted of alfalfa hay, corn stover, feeding molasses, and a grain mixture consisting of 6 parts of ground corn, 4 parts of ground oats, 2 parts of wheat bran, and 1 part of linseed oil meal, by weight. These feeds were weighed to the individual cows in the proportions of 2 parts of grain, 2 parts of hay, and 1 part of stover. One pint of molasses was diluted and sprinkled over the roughage at each feeding, or twice daily. The molasses was added to make the roughage more palatable and thus induce larger consumption. A part of the hay and stover was ground through a 7/16-inch screen in a hammer mill; the remainder of the stover was run through a silage cutter.

Whole hay, cut stover, and grain were fed to the cows in group 1 during the first period, and ground hay, ground stover, and grain during the second period. The cows in group 2 received the rations in the reverse order.

Table 48. Milk and fat produced and feeds consumed during the 6-week period, Ohio, 1928.

	Ground roughage	Unground roughage	Difference favoring ground roughage	Percent difference
Milk, pounds	15,301.6	15,008.3	293.3	1.95
Fat, pounds	585.363	571.598	13.768	2.40
4 percent milk, pounds	14,901.0	14,577.3	323.7	2.22*
Grain, pounds	6,254	6,222	32	.51
Hay, pounds	6,254	6,222	32	.51
Stover, pounds	3,127	3,111	16	.51
Molasses, pounds	1,381	1,381	--	---

*Percent net difference 1.71.

Reference: Ohio Agricultural Experiment Station Bulletin 502, "Preparation of Feeds for Dairy Cows," pages 4, 5, and 6, table 1, Wooster, Ohio, May 1932.

Feeding Ground Roughage to Dairy Cows
Part II

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Period: November 16, 1926 to May 9, 1927.

Purpose: To determine the effect of mixing grains with ground roughage.

Procedure and conditions: The 12 cows used were divided into 2 groups, consisting of 4 Holsteins and 2 Jerseys each.

The cows were weighed on 2 successive days at regular intervals. The two groups were balanced in the various factors as nearly as possible.

The roughages used in the ration consisted of equal parts, by weight, of clover, alfalfa, and timothy hay. Hays of No. 1 grade, or better, were used. The hays were ground through a 7/16-inch screen in a hammer mill and thoroughly mixed. The grain mixture consisted of 4 parts corn, 3 parts oats, 3 parts wheat bran, and 2 parts linseed oil meal by weight. Group 1 received the hay and grain thoroughly mixed together during the first period and separate during the second period. Group 2 received the feeds in the reverse order.

The cows were given as much hay and grain as they would clean up well, in the proportion of 3 pounds of ground hay to 2 pounds of ground grain. The hay and grain were fed dry. Molasses was not used to make the ration more palatable as was done in Part I.

Table 49. Milk and fat produced and feeds consumed (two, 6-week periods), Ohio, 1926-1927.

	The mixed ration	Unmixed ration	Difference	Percent difference**
Milk, pounds	9,521.3	9,552.9	—31.6	- -
Fat, pounds	449.22	446.75	2.47	---
4 percent milk equivalent*, pounds	10,546.8	10,522.4	24.4	.23
Hay, pounds	7,118.5	6,391.0	727.5	11.38
Grain, pounds	4,745.3	4,427.2	318.1	7.18
Per 100 lbs. milk:				
Hay, pounds	67.49	60.73	6.76	11.13
Grain, pounds	44.99	42.07	2.92	9.94

*Production calculated to 4 percent milk basis by Gaines formula.

**Based on results of unmixed ration.

Reference: Ohio Agricultural Experiment Station Bulletin 502, "Preparation of Feeds for Dairy Cows," pages 8 and 9, table 3, Wooster, Ohio, May 1932.

Legume Hay With and Without High Protein Concentrates for Dairy Cows

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: Four 105-day trial periods, each trial composed of 30-day experimental periods.

Purpose: To determine whether it is necessary to feed protein supplements with legume hays and carbohydrates.

Procedure and conditions: The cows used in the test were divided into two equal groups with respect to breed, stage of lactation, milk production, and body weights.

The double reversal method of feeding was followed and each trial covered a period of 105 days divided into three 30-day experimental periods, with an additional 7-day preliminary transition period preceding each experimental period.

Soybean hay was fed in the first two trials and alfalfa hay in the last two trials. Both hays were of excellent quality and since there was no significant difference in the effect of the two hays upon milk and fat production the results of all four trials have been combined in the final summary. The hay was the only source of roughage and was fed at the rate of approximately two pounds daily for each hundred pounds of liveweight. In addition to the hay one group of cows in each feeding trial received a grain mixture of 400 pounds ground corn and 200 pounds ground oats. Group 2 in each feeding trial received the same grain mixture of corn and oats plus 50 pounds of linseed oil meal. Each grain mixture contained 1 percent salt. The grain was fed at the rate of approximately one pound for each 3 pounds of milk produced daily. The amount fed each cow was determined on the basis of her production at the beginning of the trial. This accounts for the relatively large total amounts of grain in relation to the total milk production.

Table 50. Milk and butterfat production and feed consumption of cows on legume hay with and without protein supplements in the basal grain mixture*

	With protein supplement	Without protein supplement
Number cows	18	18
Total milk production, lbs.	29,533	28,922
Average daily milk production, lbs.	26.55	26.01
Total fat production, lbs.	1,144.70	1,120.50
Average daily fat production, lbs.	1.02	1.00
Total grain consumed, lbs.	11,493.00	11,349.00
Average daily grain consumption, lbs.	10.25	10.19
Total hay consumed, lbs	19,873.00	19,722.00
Average daily hay consumption, lbs.	17.89	17.75
Average initial body weight, lbs.	926.00	974.00
Average final body weight, lbs.	960.00	1,011.00
Average gain or loss in body weight, lbs.	34.00	37.00

*Basal grain mixture 400 pounds ground corn, 200 pounds ground oats.

Reference: Indiana Agricultural Experiment Station Bulletin 407, "Legume Hay With and Without High Protein Concentrates for Dairy Cows," pages 2 and 3, table 1, Lafayette, Indiana, April 1936.

Soybean Hay versus Wheat Bran and Cottonseed Meal for Milk Production

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Period: Test 1, 60 days, 1908.
Test 2, 77 days, 1909.

Purpose: To compare the milk producing qualities of soybean hay with wheat bran and cottonseed meal.

Procedure and conditions: Two tests were conducted, 11 cows were used in the first and 9 in the second trial. The cows were divided into two lots.

In the first test all cows were fed the soybean hay ration for a preliminary period of 31 days. The comparison proper lasted 60 days. In the second test both lots received the soybean hay ration for a preliminary period of 28 days. The comparison proper lasted 77 days.

In both tests lot 1 received corn silage, soybean hay, and grain mixture made up of 6 parts by weight of corn meal and 1 part cottonseed meal. Lot 2 received corn silage, corn stover, and a grain mixture made up of equal parts by weight of corn meal, wheat bran, and cottonseed meal.

Table 51. A comparison of the feeding value of soybean hay with cottonseed meal and bran, Ohio, 1908-09

	Test 1		Test 2	
	Lot 1	Lot 2	Lot 1	Lot 2
Number of cows	5	6	4	5
Feed per 100 lbs. milk, lbs.:	267.67	255.44	220.25	216.56
Corn meal	30.02	13.72	28.65	13.63
Cottonseed meal	4.97	13.72	4.88	13.63
Corn silage	182.99	175.32	144.46	146.23
Soybean hay	46.69	0.00	42.26	0.00
Bran	0.00	13.72	0.00	13.63
Corn stover	0.00	38.96	0.00	29.44
Total production per cow, lbs.	1,097.40	1,171.80	1,256.40	1,659.12
Average daily production, lbs.	18.29	19.53	20.94	21.56
Average percent fat	4.90	4.67	4.88	4.46
Average gain or loss in weight, lbs.	28.80	25.30	9.00	20.80

Reference: Ohio Agricultural Experiment Station Bulletin 267, "The Value of Soybean Hay and Alfalfa Hay in Milk Production," pages 126-128, tables 5, 7, and 13, Wooster, Ohio, December 1913.

The Value of Silage in the Dairy Ration

Conducted by: Indiana Agricultural Experiment Station.

Conducted at: Lafayette, Indiana.

Period: 3 trials in 1925.

Purpose: To determine the effect of silage in the dairy ration.

Procedure and conditions: This experiment consisted of three feeding trials. Each trial comprised three 28-day feeding periods. Each period included a 7-day preliminary period during which cows could become accustomed to a change in ration. The reversal method was used in each trial.

The comparative lots of cows used for this work were made up of cows as nearly as possible the same in average stage of lactation, body weight, and milk production. During the first and third trials two lots of four cows each were used, and during the second trial two lots of three cows each were used.

The milk produced by each cow was weighed and recorded at each milking. Composite samples of the milk of each cow were made and tested every 7 days.

Silage was carefully weighed to the cows at the rate of 3 pounds per day per 100 pounds body weight. Alfalfa hay was fed at the rate of 1 pound per day per 100 pounds body weight when silage was fed, and at the rate of 2 pounds when no silage was fed. Grain was fed at the rate of 1 pound for every 3 pounds of 4 to 6 percent milk and 1 pound for every 4 pounds of 3 to 4 percent milk produced.

Animals were weighed for 3 successive days at the beginning of each trial and at the end of each feeding period, and the average of these three weights was used as the weight of the animal at that time.

Table 52. Feeding rations with and without silage to dairy cows, average for 3 feeding trials, Indiana, 1925

	Lot 1—Silage	Lot 2—No silage
Number cows		
Trials 1 and 3	4	4
Trial 2	3	3
Production (average daily):		
Milk, lbs.	27.7	25.2
Fat, percent	3.28	3.41
Fat, lbs.	.91	.86
Average daily feed consumed:		
Grain, lbs.	7.33	7.00
Hay, lbs.	10.63	21.19
Silage, lbs.	32.20	----
Gain in body weight per cow in lbs.	26.00	16.00

Reference: Indiana Agricultural Experiment Station Bulletin 297, "The Value of Silage in the Dairy Ration," pages 4 and 5, table 3, Lafayette, Indiana, September 1925.

Increased Hay Feeding for Dairy Cows

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Period: 1934.

Purpose: (1) To increase the feeding of hay.
(2) To decrease the amount of protein of the grain mixture.
(3) To decrease the amount of silage fed.

Procedure and conditions: The herd of purebred and high-grade Holstein cows at the Trumbull County Farm, which would compare with those on good, average farms was used for this work. During the winter season the cows were confined to stanchions equipped with watering cups. In summer the herd was allowed to roam in a pasture, which, like most pastures in that section, was not always all that could be desired.

As the experiment was conducted on a "farm basis" rather than on a strictly experimental basis, it was necessary to feed the farm hay which varied in kind and quality. It is believed that the results obtained from this "mine-run" of farm hay are comparable to those which may be expected under practical conditions. In general, three types of hay were fed: (a) a mixed hay composed of alfalfa and timothy of the first cutting; (b) second-cutting alfalfa, which contained some second-growth timothy; and (c) mixed alsike and medium red clover. A good quality of corn silage was available throughout the test.

The grain mixtures used are shown in the following table:

	Mixture 1	Mixture 2
Corn-and-cob meal, lbs.	500	400
Oats, lbs.	300	400
Bran, lbs.	100	200
Soybean oil meal, lbs.	100	----
Cottonseed meal, lbs.	100	----
Salt, lbs.	11	10
Digestible crude protein, percent	13.2	8.7
Total digestible nutrients, percent	74.6	71.3

Table 53. Production and feed consumption before and after increase in hay feeding, 320 days, Ohio, 1934

	Reduced grain 320-day lactation			Grain not reduced 320-day lactation		
	Light hay	Moderate hay	Difference	Light hay	Moderate hay	Difference
Production:						
Milk, lbs.	11,699	9,374	2,325	9,489	10,656	1,169
Butterfat, lbs.	399	316	83	322	350	28*
Fat test, percent	3.41	3.37	0.04	3.39	3.28	0.11
4 percent (F.C.M.) lbs.	10,663	8,487	2,176	8,623	9,512	889
Feed consumption:						
Grain, lbs.	3,453	2,401	1,052	2,853	2,838	15
Hay, lbs.	2,318	4,242	1,924*	2,219	4,154	1,935*
Silage, lbs.	8,528	6,043	2,485	8,222	6,165	2,057
Digestible protein, lbs.	718	690	28	628	744	116*
T.D.N., lbs.	5,253	4,995	258	4,701	5,298	597*
Feed per 100 lbs. 4 pct. milk:						
Grain, lbs.	32.38	28.29	4.09	33.16	29.84	3.32
Hay, lbs.	21.74	49.98	28.24*	25.73	43.67	17.94*
Corn silage, lbs.	79.98	71.20	8.78	95.35	64.81	30.54
Milk per pound of grain, lbs.	3.39	3.90	0.51*	3.33	3.75	0.42
4 percent milk per pound of grain, lbs.	3.09	3.53	0.44*	3.02	3.35	0.33

*Higher value for moderate hay.

Reference: Ohio Agricultural Experiment Station Bulletin 538, "Alfalfa-Timothy Hay for the Dairy Farm," pages 24, 25, 27, and 28, tables 2, 4, and 5, Wooster, Ohio, August 1934.

Light versus Heavy Hay Feeding

Conducted by: Ohio Agricultural Experiment Station.

Conducted at: Wooster, Ohio.

Period: 1934.

Purpose: To compare light versus heavy hay feeding for dairy cattle.

Procedure and conditions: A 31-day double reversal trial with six cows approaching the end of their milking periods was conducted.

Each cow was fed daily 30 pounds of hay, 15 pounds corn silage and grain mixture No. 2 (8.7 percent protein) according to milk production. The check ration (light hay) consisted of 15 pounds of 0.45 pounds corn silage per day and grain mixture No. 1 (13.2 percent) fed according to milk production.

The grain mixtures used are shown in the following table:

	Mixture 1	Mixture 2
Corn-and-cob meal, lbs.	500	400
Oats, lbs.	300	400
Bran, lbs.	100	200
Soybean oil meal, lbs.	100	
Cottonseed meal, lbs.	100	...
Salt, lbs.	11	10
Digestible crude protein, percent	13.2	8.7
Total digestible nutrients, percent	74.6	71.3

Table 54. Light versus heavy hay feeding, 31-day double reversal, Ohio, 1934

	Light hay	Heavy hay	Difference
Production:			
Milk, lbs.	587.4	553.9	33.5
Butterfat, lbs.	20.1	20.3	0.2*
Fat test, percent	3.42	3.66	0.24*
4 percent milk (F.C.M.), lbs.	536.4	525.9	10.5
Feed consumption:			
Grain, lbs.	197.0	136.0	61.0
Hay, lbs.	465.0	930.0	465.0*
Corn silage, lbs.	1,395.0	465.0	930.0
Feed per 100 lbs. 4 percent milk:			
Grain, lbs.	36.63	25.86	10.77
Hay, lbs.	86.69	176.83	90.14*
Corn silage, lbs.	260.01	88.42	171.59
Milk per pound of grain, lbs.	2.98	4.07	1.09*
4 percent milk per pound of grain, lbs.	2.72	3.87	1.15*

*Higher value for heavy hay.

Reference: Ohio Agricultural Experiment Station Bulletin 538, "Alfalfa-Timothy Hay for the Dairy Farm," pages 25, 28, and 29, tables 2 and 6, Wooster, Ohio, August 1934.

Pastures for Dairy Cattle

Under Mississippi conditions it does not seem advisable for producers to go into the production of milk unless a sufficient acreage is available and unless sufficient care is to be given to provide the needed pastures. Under normal conditions cattle can be provided with grazing from 6 to 8 months of the year, or even longer, by providing supplemental grazing crops. Feed bills can be materially reduced if dairy cattle are on pastures. Information presented below will show the value of pastures as well as the value of improved practices in connection with pastures, such as fertilizing and mowing. The development of satisfactory pastures should certainly be included in the plans of every farmer who anticipates going into milk production in Mississippi.

Value of Pasture for Dairy Cows

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1924-1926.

Purpose: To compare the production of milks cows with and without pasture.

Procedure and conditions: During the summer of 1924, five cows on good pasture were compared with five cows on poor pasture for a period of 168 days. This test was repeated in 1925 with two lots of four cows each for a period of 161 days. The average results of these 2 years preliminary work indicate that a cow on good pasture can secure sufficient feed for maintenance and for the daily production of 14 pounds of milk testing 4 percent butterfat. In 1926, a test was made by dividing 12 cows into 3 lots as follows: Lot 1 was on good pasture during the first and third periods and in a dry lot during the second period. Lot 2 was in a dry lot during periods 1 and 3 and on good pasture during period two. Lot 3 was on good pasture for all three periods. One week was allowed between each period for making the change from one feed to another. The results of these tests are shown in table 55.

Table 55. Value of pasture for dairy cows, State College, Mississippi, 1924-26

	Lots 1 and 2	Lots 1 and 2	Lot 3
	No pasture	Good pasture	Good pasture
Number cows on test	4	4	4
Days on test	168	168	168
Gain or loss in liveweight	—27	529	365
Production:			
Milk, lbs.	12,142	13,071	13,772
Fat, percent	3.95	3.96	4.58
Fat, lbs.	479.5	518.4	631.7
Feed consumed:			
Grain, lbs.	4,508	2,114	2,107
Hay, lbs.	10,976	......	....

Reference: Mississippi Agricultural Experiment Station Bulletin 259, "Feed, Care and Management of the Dairy Cow," page 13, State College, Mississippi, January 1928.

Improving and Maintaining Pasture Land in Mississippi

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: State College, Mississippi.

Period: 1930-39.

Purpose: To determine the labor and cost of improving and maintaining permanent pasture and the value of good pasture in terms of feeds bought or grown.

Procedure and conditions: Several years prior to the starting of this test 6 acres of land on a rather steep hillside and unsuitable for cultivation was stopped of gullies, fertilized with 12.5 tons barnyard manure per acre, and planted to grasses and clovers for pastures for which it was well suited. At the time this project was started there was a good sod of grasses and clovers and it would have been called a good pasture. This was set aside to be used as a pasture for the dairy cows. During the 10 years of the experiment an average of 2.6 tons of barnyard manure was applied each year.

Four cows, or one cow for each 3½ acres of pasture and cropland, were originally selected. This provided only 1½ acres of pasture per cow, which would have been insufficient except for the fact that several years had been spent in making this 6 acres a good pasture. Because of this and further improvement of pasture land throughout the experiment, it was possible later on to increase the number of cows from four to six, so that the average pasturage per cow for the 10 years was 1.25 acres. This area furnished pasture for an average of 257 days per year.

Cows for this experiment were chosen from the college dairy herd, representing as nearly as possible the average cow in the herd. When it was necessary to replace any animal or add others the same policy was followed.

Table 56. Maintaining a 6-acre pasture for 10 years, Mississippi, 1930-1939

	Hours labor on pasture		
	Man	Horse	Tractor
Hauling and spreading manure	460.0	920.0	
Seeding, 106 lbs. white clover	8.0	—	—
Mowing	58.2	114.8	1.8
Terracing	10.8	10.0	0.8
Fencing and repairs	59.5		
Other items:*			
26 tons manure			
106 lbs. white clover seed			
Totals	596.5	1,044.8	2.6

*Items of cost which along with man, horse, and tractor labor might be estimated of local current prices.

Reference: Mississippi Agricultural Experiment Station Bulletin 343, "The Place of Dairying in Mississippi," pages 3, 4, 5, and 6, table 2, State College, Mississippi, May 1940.

Fertilizing Pastures

Conducted by: Holly Springs Agricultural Experiment Station.

Conducted at: Holly Springs, Mississippi.

Period: 1937-40.

Purpose: To determine the effect of different fertilizer treatments on the yield of dry matter in pasture.

Procedure and conditions: An established permanent pasture at Holly Springs that would be considered an average of the pastures in the hill sections of this area was used for this test. A series of fertilizer treatments was applied broadcast in February on random plots throughout the pasture. One application of lime was made during the period, all other treatments being annual applications. Check plots were left untreated for comparison.

Areas of both fertilized and check plots were protected from grazing by means of movable cages. Total yields were obtained by harvesting the growth at frequent intervals so as to simulate grazing conditions. Unprotected areas of the same size and number, treated and untreated, and representative of the growth left by grazing cattle, were clipped at the same time. All yields are reported as dry matter per acre. The difference between the yields of the protected areas and yields of the unprotected areas represents the quantity of pasture growth that was eaten by the grazing dairy animals. These differences

Table 57. Influence of fertilization on the yield and grazing of top-dressed pastures on Grenada soil, Mississippi, 1937-1940

Fertilizer treatment	Pounds dry matter per acre av. 1937-40	Percent of growth not grazed
L—Lime 4,000 lbs. (applied 1937)	2,904.0	32.16
P—400 lbs. superphosphate (20 percent)	6,193.6	6.44
N—250 lbs. nitrate of soda (16 percent)	3,891.3	40.12
K—80 lbs. muriate of potash (50 percent)	3,742.8	22.43
LP*	5,237.0	5.64
LK*	4,006.0	18.27
LN*	4,858.7	30.09
LPK*	4,561.5	15.80
LPKN*	5,542.6	25.13
None	3,236.3	23.91

*Combination of lime and phosphorus, nitrogen, and potash in quantities listed in first four lines of table.

are reported as the percentage of growth not eaten. Four-year averages of yields and rate of grazing are reported in tables 57 and 58.

Table 58. The effect of a single application and of four annual applications of superphosphate, Mississippi, 1937-1940

Treatment	Pounds of dry matter per acre			
	1937	1938	1939	1940
Check	1,763.3	3,912.3	3,578.2	3,691.2
400 lbs. super in 1937	3,097.3	6,324.9	4,399.8	4,495.2
400 lbs. super annually	3,097.3	8,787.2	5,769.3	7,120.5
		Percent increase over check		
400 lbs. super in 1937	75.7	61.6	23.0	21.8
400 lbs. super annually	75.7	124.6	61.2	92.9

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," pages 28 and 29, tables 15 and 16, State College, Mississippi, July 1941.

Liming Pastures

Conducted by: Mississippi Agricultural Experiment Station.

Conducted at: Pearl River County, Mississippi.

Period: One year, 1940.

Purpose: To determine the effect of lime, with superphosphate, on the yield of dry matter.

Procedure and conditions: The response of Norfolk soil to small quantities of lime is shown by the yield of pasture clippings from a pasture growing on Norfolk very fine sand. A carpet grass-lespedeza hill pasture on this soil type in Pearl River County was top dressed in January 1940, with varying amounts of dolomitic limestone in combination with 200 pounds of 20 percent superphosphate. The dry matter produced per acre is shown in table 59.

Table 59. Effect of top dressing with varying amounts of lime on Norfolk very fine sand

Pounds applied per acre			Yield
Dolomite	plus	Superphosphate	Pounds dry weight per acre
80	plus	200	2,095.7
160	plus	200	2,273.4
240	plus	200	2,517.5
320	plus	200	2,695.5
480	plus	200	4,124.7
960	plus	200	3,554.5
No treatment			1,399.6

Reference: Mississippi Agricultural Experiment Station Bulletin 356, "Pastures in Mississippi," page 31, table 19, State College, Mississippi, July 1941.

Improvement of the Pasture by Mowing

Time of mowing is one of the more important pasture improvements farmers can employ in Mississippi. This is especially true with soils of medium or low fertility. The desirable plants are in competition with the undesirable plants for soil moisture and plant food. A number of the undesirable plants are able to grow on soils of lower fertility than are grasses and legumes. Weeds and sedge usually grow taller, tending to shade out the desirable plants. There are a number of undesirable plants which can be controlled satisfactorily by mowing. The following figures show how the undesirable plants will spread if allowed to seed.

Table 60. Seed production of some pasture weeds

Plant	Heads per plant	Seed per head	Seed per plant
Bitterweed (Hellenium tenufolium)	24	130	3,120
Mayweed (Anthemis cotula)	12	169	2,028
Thistle (Circium lanceolatum)	12	863	10,356
Daisy fleabane (Erigeron philadelphicus)	93	245	22,785
Curled-leaf dock (Rumex crispus)	...	...	10,506

The palability of pasture grasses is greatly improved by mowing. Grazing tests have been made on mowed and unmowed plots. The following table shows the comparison of mowed and unmowed plots.

Table 61. Effect of mowing on the yield and composition of pasture material

Treatment	Dry wt. yield	Seasonal averages	
		Pct. not eaten	Pct. protein
Mowed	4,052.6	20.28	11.76
Unmowed	4,386.6	50.18	6.92

Reference: Mississippi Agricultural Experiment Station Bulletin 356, 'Pastures in Mississippi," pages 22, 23, and 24, tables 13 and 14, State College, Mississippi, July 1941.

Grain as a Supplement to Pasture and Other Roughage for Milk Production

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: 3 years, December 1929 to December 1932.

Purpose: To determine the rate of feeding grain that is most profitable for milk production.

Procedure and conditions: Three groups of 9 cows each (6 Holsteins and 3 Jerseys) were picked. The cows freshened from the middle of August to the end of December, and had a normal record starting at approximately the same time. They were fed as follows:

1930: Group 1. Grain fed at full rate, 1 pound grain to each 4 pounds of Holstein milk, or 1 pound grain to each 3 pounds Jersey milk. For 30 days previous to calving, all cows fed 4 pounds grain per day in fall and winter.

Group 2. Grain fed at limited rate, 1 pound grain to each 6 pounds of Holstein milk, or 1 pound grain to each 4.5 pounds Jersey milk. Each cow fed 2 pounds grain in fall and winter, 30 days previous to calving.

Group 3. No grain fed, roughage only.

1931: Group 1. Very limited amount of grain.

Group 2. Same as previous year.

Group 3. Full fed at about same rate as group 1 during first year.

1932: Group 1. Consisting of four cows previously on low grain ration and four on full grain ration, were fed a limited grain ration for this year.

Group 2. Consisting of two cows previously on low grain and five on limited grain were full fed the third year.

All cows had access to the same alluvial land pastures which consisted mainly of White Dutch clover and Dallis grass with considerable Bermuda in late summer. Certain pastures contained Italian rye grass. Oats were pastured during a part of the first year. The dry weather early in 1930 and midsummer of 1931 decidedly reduced the grass supply per cow.

Table 62. The effect of rate of feeding grain on profit derived from dairy cows at Baton Rouge, Louisiana, 1930-31

	Lot 1			Lot 2			Lot 3		
	1929	1930	1931	1929	1930	1931	1929	1930	1931
Rate of feeding grain	Full	Full	Low	Full	Ltd.	Ltd.	Full	None	Full
Lactation days per cow	291	321	288	311	293	271	303	279	299
Total milk, lbs.	6,525.2	6,208.1	6,766.3	7,257.1	7,272.3	6,535.4	8,004.3	4,545.5	7,575.4
Milk per day, lbs.	22.42	19.40	23.49	23.33	24.82	24.11	26.42	15.3	25.33
Total butterfat, lbs.	259.0	232.7	257.6	269.6	273.9	232.6	301.5	175.0	278.6
Grain, lbs.	1,993.0	1,966.0	1,286.0	2,091.0	1,609.0	1,488.0	2,389.0	27.0	2,611.0
Hay, lbs.	595.0	821.0	1,038.0	602.0	957.0	907.0	724.0	1,066.0	854.0
Silage, lbs.	4,769.0	4,444.0	3,994.0	4,445.0	4,580.0	3,540.0	5,611.0	5,492.0	4,057.0
Loss in weight, lbs.		55.0	—47	12	0.0	--------	--------	—30.0	19.0
4 pct. corrected milk yield	6,495.1	5,973.7	6,570.5	6,946.8	7,017.4	6,103.2	7,724.2	4,473.2	7,209.2
Lbs. milk per lb. grain	3.26	3.04	5.11	3.32	4.36	4.10	3.23	---	2.76

The normal production in 1929 is given as a check against the results of the test.

Reference: Louisiana Agricultural Experiment Station Bulletin 241, "Grain as a Supplement to Pasture and other Milk Roughage for Milk Production," pages 2, 3, 6, and 8, table 3, Baton Rouge, Louisiana, October 1933.

From October to March roughage was fed in indirect proportion to grain and consisted of legume hay and corn and soybean silage. Grain consisted of a mixture of 400 pounds corn meal or hominy, 200 pounds each of wheat bran, oats, and cottonseed meal, 15 pounds of salt, and 10 pounds of bonemeal, and was used throughout the first 2 years. Bonemeal was fed with the roughage at the rate of 4 ounces, and 2 ounces, respectively, to the low grain groups, but was not used at all the third year.

Permanent Pasture for Dairy Cattle

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Claiborne, Lincoln, and Washington Parishes.

Period: 4 years, 1937-1940.

Purpose: To compare improved and unimproved permanent pastures on Louisiana dairy farms.

Procedure and conditions: Each test pasture was divided into halves, and each half was treated alike except that one received fertilizer and the other did not. The fertilized half received 350 pounds per acre of complete fertilizer (4-12-4) during October or early November of each year. In addition, 50 pounds of nitrate of soda per acre were applied during May of each year. The amount and kind of fertilizer used was not considered the very best for each particular pasture. There was evidence, however, that each test area had soils deficient in both phosphorus and nitrogen, and possibly potash. Also, previous work in the State had shown that best results were secured when all three major plant food elements were applied at the approximate rate used in this test. Two of the three test areas reported on received applications of limestone to correct the soil acidity. In the fall of 1940, basic slag was applied at the rate of 600 pounds per acre to the previously unfertilized half of each test. The halves receiving the annual application of 4-12-4 and nitrate of soda, were treated the same as in the past, with the exception of one test in which case no fertilizer was applied.

Test pastures, including those not fertilized, were seeded to clovers and dallis grass. The clovers included white Dutch, hop and bur. Annual fall seedings of either oats or rye grass were made for 2 years on one test and for 3 years on another. Weeds were controlled by two or more mowings each year. Producing Jersey cows grazed each test pasture and were rotated between pasture areas in order to graze the fertilized and unfertilized halves to the same degree of closeness.

Table 63 gives the averages of three tests: Washington, Lincoln, and Claiborne Parishes.

Table 63. Fertilized and unfertilized pasture for dairy cows, Louisiana, 1937-1940

	1937	1938	1939	1940	Average
Number days grazed					
Unfertilized	56	72	75	79	70
Fertilized	83	99	123	127	110
Cow days per acre					
Unfertilized	101	114	121	171	127
Fertilized	158	164	212	266	200
Pounds milk yearly per acre					
Unfertilized	1,827	2,225	2,092	3,226	2,342
Fertilized	3,138	3,195	3,722	5,350	3,851
Tons air-dry hay per acre					
Unfertilized	.95	1.35	1.61	2.80	1.68
Fertilized	1.51	1.32	2.69	3.27	2.20

Table 64. Response of pastures receiving basic slag compared to the 4-year yield of fertilized and unfertilized pastures (av. of 3 tests)

Unit of measure	Fertilized*		Unfertilized 1937-40 basic slag in 1941	
	Av. yield per acre 1937-40	1941 yield per acre	Av. yield per acre 1937-40	1941 yield per acre
Cow days grazing per acre	200	270	127	204
Increase over 4-yr. av., percent	--	35		61
Pounds milk per acre	3,851	4,884	2,342	3,915
Increase over 4-yr. av., percent	----	27	--	67

*One of the fertilized pastures did not receive its usual application of fertilizer for the 1941 season but had been regularly treated for the previous 4 years.

Reference: Louisiana Agricultural Experiment Station Bulletin 341, "Profitable Permanent Pasture for Dairy Cows," pages 3, 4, 5, 7, and 14, tables 1, 2, 3, and 7, Baton Rouge, Louisiana, March 1942.

All-Year Pasturing With and Without Concentrates for Dairy Cattle

Conducted by: West Tennessee Agricultural Experiment Station.

Conducted at: Jackson, Tennessee.

Period: October 1, 1931 to January 1, 1936.

Purpose: To determine the practicability of producing milk when grain is not fed to dairy cows that are supplied with all-year pasture, alfalfa hay, and silage.

Procedure and conditions: Thirteen purebred Jerseys have been included in the trial. At the time of entering the experiment, 2 had previous records of production and 11 were first calf heifers. All heifers used have been raised on the Station farm.

The cattle are divided into two groups. Sixty days before the expected

Table 65. All-year pasture with and without concentrates for dairy cattle, West Tennesee, 1931-36

	Group 1	Group 2
	No grain	Grain 1:3
Number lactations	16.00	17.00
Average age beginning of lactation	4 yr., 4 mo.	3 yr., 6 mo.
Average body weight beginning dry period	885.00	834.00
Average days dry	62.00	62.00
Average days lactation	312.00	313.00
Feed required:		
Grain mixture, lbs.	0.00	1,979.00
Alfalfa hay, lbs.	2,246.00	1,864.00
Silage, lbs.	2,206.00	1,933.00
Pasture:		
Permanent, days	138.00	144.00
Crimson clover, days	151.00	155.00
Sudan grass, days	51.00	41.00
Total days on pasture	340.00	340.00
Production:		
Milk, lbs.	5,883.00	6,659.00
Fat, percent	5.82	5.61
Fat, lbs.	342.39	373.51
Body gain, lbs.	30.00	31.00

Reference: West Tennessee Agricultural Experiment Station Bulletin 58, "All-Year Pasturing With and Without Concentrates for Dairy Cattle," pages 1, 2, and 3, tables 1, 2, and 3, Knoxville, Tennessee, April 1936.

freshening date, cows or heifers are placed in their respective groups. Heifers are alternately placed in the groups as they become available and remain in their group two full lactation periods, and then are placed in the other group, where they again remain two full lactation periods.

Group 1 was fed all-year pasture, silage, and alfalfa hay; group 2 the same roughage and pasture as group 1, with the addition of 1 pound of grain mixture to each 3 pounds of milk produced, and 4 pounds of grain per head daily for the dry period, with the exception of a 10-day "drying-off" period immediately following the end of the lactation. Alfalfa hay was available all the year when the cows were in the barn.

Comparison of Pasture Alone with Pasture Plus Grain and Silage Compared With Other Roughages for Dairy Cows

Conducted by: Michigan Agricultural Experiment Station.

Conducted at: East Lansing, Michigan.

Period: 1932-36.

Purpose: To determine the effects of feeding dairy cows grain while they are on pasture and to compare silage and other roughages.

Procedure and conditions: This study was made in Michigan with farmers throughout the state, 499 records being kept during the 5 years. The average size of the herds was about 13 cows.

At the end of each year the records were checked by a member of the Farm Management Department of Michigan State College.

Table 66. Comparison of grain feeding on pasture with no grain on pasture, Michigan, 1932-36

Item	Grain fed all year	No grain 1-3 months in summer	No grain 4 months or more in summer
Number of farms	329.0	107.0	63
Number of cows per farm	12.7	12.1	12.0
Butterfat production per cow, lbs.	357.0	317.0	277.0
Milk production per cow, lbs.	8,136.0	7,457.0	6,479.0
Feed consumption per cow in year:			
Concentrates, lbs.	2,485.0	1,748.0	1,073.0
Hay, lbs.	3,177.0	3,219.0	2,807.0
Silage, lbs.	5,040.0	4,639.0	4,247.0
Other roughage, lbs.	539.0	740.0	1,169.0
Pasture, days	164.0	166.0	176.0

Table 67. Comparison of herds not fed silage with those fed silage, Michigan, 1932-36

	No silage	Silage
Number of farms	69.0	430.0
Number of cows per farm	9.7	12.8
Butterfat production per cow, lbs.	314.0	342.0
Milk production per cow, lbs.	6,897.0	7,905.0
Annual consumption per cow:		
Concentrates, lbs.	1,987.0	2,187.0
Hay, lbs.	3,413.0	3,107.0
Silage, lbs.	...	5,434.0
Other roughage, lbs.	1,532.0	510.0
Pasture, days	177.0	164.0

Reference: Michigan Agricultural Experiment Station Special Bulletin 297, "Profitable Dairy Management," pages 4, 11, and 27, tables 8 and 10,

Calculating Rations for Dairy Cows

After a thorough study of the experimental information has been made and a decision has been reached as to the feed sto use in feeding dairy cattle for milk production, it is important that a ration be calculated of the feeds selected in order that the cows will receive the amount of feed nutrients that are needed. In order to determine the amounts of the different feeds selected to use, it is necessary to understand the nutritive requirements of different cattle. Information is available whereby a person may calculate the food nutrients required for a given size dairy cow producing a specified amount of milk. The feed nutrients required for an 800 pound dairy cow giving 2 gallons of 4½ percent milk is given below in the following table:

	Digestible crude protein pounds	Total digestible nutrients pounds
For maintenance	0.56	6.34
For 2 gals. milk (16.6 lbs.)	.95 to 1.15	5.61 to 6.24
Total requirements	1.51 to 1.71	11.85 to 12.58

When the requirements have been determined it is then necessary to set up a ration that will supply the nutrients needed as near as is possible to calculate.

In order to make the calculations, determining the number of pounds feed required, it is necessary to know the food nutrients contained in the different types of feed. Information as to the chemical analysis is available from several sources. A very good source for this information is Henry and Morrison's "Feeds and Feeding." The feed nutrients contained in the feeds selected to be used in feeding should be determined, and trial rations set up until one is calculated that will meet the actual requirements as nearly as possible. These calculations may be made by taking a given number of pounds of feed to be used and multiply by percentage of food nutrients contained in the particular types of feed being calculated. For example, a ration of cottonseed meal 2 pounds, corn-and-cob meal 4 pounds, clover and mixed grass hay 15 pounds, contain 1.685 pounds of digestible crude protein and 11.83 pounds of total digestible nutrients, which comes within the range covering the requirements of an 800-pound dairy cow giving 2 gallons of 4½ percent milk. These figures were arrived at by multiplying the 2 pounds cottonseed meal by 37 percent, which is the protein content of the cottonseed meal, and by 79 percent, which is the total digestible nutrient content of cottonseed meal. The calculations for the corn-and-cob meal and the clover and mixed hay were made in the same manner, taking the actual feed nutrients contained from Henry and Morrison's "Feeds and Feeding" for each of the feeds in the ration.

As a means of comparing feeding systems being used it is suggested that the actual feed nutrients of rations being fed by farmers in a given community should be determined and compared with the actual nutrient requirements to determine whether cows are receiving a sufficient amount of feed. Such a study would emphasize the fact that individual farmers may need to adjust the feeding system used in order to get more efficient production from the dairy herd.

Rations given below in table 68 were actually used by farmers in Mississippi.

Table 68. Rations that are being fed dairy cows by farmers in Mississippi

Kind and amount of feed		Digestible crude protein	Total digestible nutrients
	Pounds	Pounds	Pounds
Ration No. 1			
Cottonseed meal	5	1.85	3.90
Cottonseed hulls	8	.02	2.96
Total		1.87	6.85
Ration No. 2			
Crushed ear corn	3	.18	2.34
Grass hay	12	.56	5.70
Total		.74	8.04
Ration No. 3			
Crushed corn	4	.24	3.31
Cottonseed meal	2	.74	1.56
Hay	12	.56	5.70

The question may well be raised whether cattle receiving these rations are getting enough feed to produce as efficiently as they might. It is possible to have many combinations of rations. A few sample rations using different feeds and combinations of feed are given. These sample rations for feeding an 800-pound dairy cow giving 2 gallons of 4½ percent milk are shown in table 69.

Table 69. Sample rations for feeding an 800-pound dairy cow giving 2 gallons of 4½ percent milk

Kind and amount of feed		Digestible crude protein	Total digestible nutrients
	Pounds	Pounds	Pounds
Ration No. 1			
Cottonseed meal	2	.74	1.58
Corn-and-cob meal	4	.24	3.12
Clover and mixed grass hay	15	.705	7.13
Total		1.685	11.83
Ration No. 2			
Cottonseed meal	2½	.93	1.97
Corn-and-cob meal	3	.18	2.34
Ground oats	3	.27	2.12
Johnson grass hay	6	.17	3.00
Sorghum silage	20	.01	2.66
Total		1.56	12.09
Ration No. 3			
Corn-and-cob meal	6	.36	4.69
Ground oats	5	.49	3.52
Soybean hay	7	.82	3.75
Total	----	1.67	11.96
Ration No. 4			
Cottonseed meal	3	1.11	2.35
Corn-and-cob meal	3	.18	2.34
Cottonseed hulls	10	.03	3.70
Grass hay	8	.28	3.66
Total	----	1.60	12.05
Ration No. 5			
Corn-and-cob meal	6	.37	4.69
Soybean hay	15	1.76	8.04
Total	----	2.03	12.73

Some Characteristics of a Good Ration

In the formulation of a ration that has the proper amount of digestible protein and total digestible nutrients, there are certain other factors that should be taken into consideration.

Palatability. The ration fed should be palatable to the cow if profitable production is to be obtained. If unpalatable the cow will limit her feed consumption, resulting in reduced milk production. Particularly the roughages should be palatable, as they form the most economical part of the ration. Cows fed the finest quality of alfalfa hay as the only roughage will consume about 3 pounds daily per 100 pounds of liveweight, or about 30 pounds daily for a 1000-pound cow. If the cow is fed 30 pounds of palatable silage daily, the alfalfa hay consumption will decrease to about 20 pounds daily.

Variety. It may be desirable to have as many good feeds in the ration as economically possible. Each feed differs in composition and a variety gives greater assurance of providing adequate amounts of essential amino acids, minerals, and vitamins. It is desirable to make the concentrate mixture from at least four plant sources. A ration containing a variety of feeds is usually more palatable to the cow.

Bulk. Nature has provided the cow and other ruminants with a digestive system adapted to utilizing large amounts of bulky feeds. In order to insure proper functioning of the digestive tract, the ration must contain sufficient bulk. Too heavy a concentrate mixture is apt to cause cows to go off feed. The grinding of farm grains too finely is not desirable if they are to form a high percentage of the concentrate mixture.

It should be pointed out that the ration may be too bulky for the best results. This would be true if the roughage were more or less limited to succulent feeds, such as the root crops, apples, kale, squash, and early spring pasture, which are low in dry matter content. A cow might eat to her capacity of 100 to 150 pounds daily of succulent feeds high in water content, but because of the low dry matter and digestible nutrient value, she would decline in production. For best results succulent feeds high in water content should be limited to about 3 pounds daily per 100 pounds body weight. As previously discussed, silage crops may be fed in larger amounts.

Physiological effects. The dairy cow's ration should keep her in good physical condition. Some feeds are laxative and some constipating in effect. Rations causing either extremes are not desirable. Overfeeding on some of the succulent feeds, linseed oil meal, molasses and other laxative feeds is not desirable. A ration of dry hay and heavy grain may cause constipation. Linseed oil meal in the ration is a good conditioner and causes the cow's hair to become soft and glossy and enables her to place soft fat on the body when not milking. The complete ration should be mildly laxative. This is especially true at calving time.

Cost of the ration. Studies made in Oregon* show that feed cost is about one-half of the total cost of milk and butterfat production. In many cases the feed cost can be reduced by utilizing available information on the most profitable feeds to grow in different localities, on different soil types, and under various climatic conditions. Usually roughages and farm grains can be more economically grown than purchased. Legume hays grown on the farm are desirable because it is then not necessary to purchase a large amount of high-priced protein concentrates. The availability of good pastures either with or without irrigation is closely related to low production costs. The comparative value of feeds should be carefully considered in determining the crops to grow and the feeds to purchase.

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*Oregon Agricultural Experiment Station Bulletin 318.

Reference: Oregon Agricultural Experiment Station Bulletin 298, "Feeding for Milk Production," pages 27 and 28, October 1941.

PRODUCTION OF REPLACEMENT STOCK FOR DAIRY STOCK

The success of a milk producing enterprise depends a great deal on maintaining relatively young, high producing cows. It is generally agreed that younger cows, up to 8 or 10 years of age, are more efficient producers of milk than older cows. If the average age of a dairy herd is to be kept at a relatively low point it is necessary that young replacement stock be produced or purchased. It would not be possible for all producers to purchase replacement stock. It is necessary that many dairymen, perhaps most dairymen, produce their own replacement stock.

This is one practice that has been neglected by many dairymen, and difficulty has been encountered in securing young animals to maintain herds.

In many cases producers who have undertaken the production of replacement stock have given inadequate management to that phase of the dairy enterprise, resulting in the raising of a very small percentage of calves born. To produce calves successfully requires a great deal of care and attention. One of the more common causes of failure in the production of dairy calves is neglect resulting in occurrence of white scours which kills, no doubt, a higher percentage of calves than any other ailment. A discussion of this disease and its treatment is given in the disease and parasite sections of this publication. It is important that this disease be controlled if a producer is to be successful in raising dairy calves.

It is important that dairy producers exercise enough care and attention to produce good, healthy, vigorous animals, as the type of cow that will result depends somewhat on the treatment that the young calves have gotten. To produce healthy, vigorous animals it is necessary that they receive a sufficient amount of feed. Experimental tests have been selected and placed in this section that should be helpful to producers in setting up a feeding system to use in the production of replacement stock for dairy herds in Mississippi.

In the production of replacement stock the use of good bulls is very important and is one means whereby a herd may be improved. After the data on feeding calves, the results of experimental tests are presented to show improvements that may be expected when good bulls are used.

Different Levels of Milk Feeding for Dairy Calves

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: 1931.

Purpose: To compare the effect of different levels of feeding milk on the weight and feed consumption of dairy calves.

Procedure and conditions: Three groups of animals consisting of six Holstein calves each were used for a short test during the fall of 1931. Three levels of milk feeding were compared. Group 1 received 9 pounds of milk per day and was fed liberally on a grain mixture containing 25 percent skim milk powder. Calves in group 2 received 6 pounds of whole milk daily and the same grain mixture as those in group 1. In most cases calves were denied liquid milk after 60 days, but in order to get good results exceptions were sometimes made to this rule. The calves in group 3 were handled and fed in the regular manner and received an average of around 13 pounds of milk daily. The results of this trial are shown in table 70.

Table 70. Minimum requirements of whole milk for producing dairy calves, Louisiana, 1931

To 6 months of age	Group 1 9 lbs.	Group 2 6 lbs.	Group 3 13 lbs.
Days fed whole milk	48	56	65
Pounds whole milk	458	408	835
Pounds skim milk	543	812	1,878
Pounds skim milk powder	135	128	66
Pounds grain	404	389	363
Average weight at 6 months	298	284	308

Reference: Louisiana Agricultural Experiment Station Bulletin 342, "Feeding and Management of Dairy Calves," pages 3 and 4, table 1, Baton Rouge, Louisiana, March 1942.

Feed Consumption of Dairy Heifers to Freshening Date

Conducted by: Louisiana Agricultural Experiment Station.

Conducted at: Baton Rouge, Louisiana.

Period: 1928-1935.

Purpose: To compare the feed consumption and cost of raising different breeds of dairy heifers.

Procedure and conditions: Records were kept on feeds consumed by Holstein and Jersey heifers within the L.S.U. dairy herd.

Young calves were allowed to secure the first milk of their mothers (colostrum) by sucking the first 24 hours and then by being hand-fed with their milk for at least the next 48 hours. The monthly consumption of milk fed was secured from a summary of the weighted daily amounts fed. A complete record of the individual amounts of grain and roughage fed was not kept but was determined from records kept on a smaller lot, of similar sized heifers.

Table 71. Feed consumption of Jersey and Holstein heifers to freshening date in Louisiana, 1928-1935

	Jersey heifers				Holstein heifers			
	To 6 months	To 12 months	To freshening	Total	To 6 months	To 12 months	To freshening	Total
Number heifers	115	109	60	284	203	198	118	529
Days fed whole milk	79	78	86	243	67	67	68	202
Days fed skim milk	103	205	222	530	110	167	169	446
Pounds whole milk	794	807	858	2,459	784	792	827	2,403
Pounds skim milk	1,067	2,186	2,449	5,702	1,284	1,904	2,175	5,364
Pounds skim milk powder	43	120	118	281	61	83	60	204
Pounds gain	234	656	1,217	2,107	248	568	896	1,712
Pounds hay	190	433	2,007	2,625	186	331	2,589	3,106
Pounds silage	35	220	1,842	2,097	52	174	1,934	2,160

Reference: Louisiana Agricultural Experiment Station Bulletin 342, "Feeding and Management of Dairy Calves," pages 3 and 6, tables 3 and 4, Baton Rouge, Louisiana, March 1942.

Raising Dairy Calves by a Limited Milk Feeding Plan

Conducted by: South Carolina Agricultural Experiment Station.

Conducted at: Clemson, South Carolina.

Period: 1929-1932-1933.

Purpose: To learn the minimum age at which a calf may be weaned from milk and what feeds would serve to grow calves to normal development after weaning.

Procedure and conditions: Purebred calves of the Jersey, Guernsey, and Holstein breeds born in the experiment station herd were used exclusively in these tests. In selecting calves for the individual group, all calves of approximately the same age at the time a test was started were included without discrimination in regard to birth, weight, thrift, breed, or sex.

Ground yellow corn and ground oats were used as the basis for all mixtures, the source of protein being the variable factor in all the rations. Fish meal alone and in combination with skim milk powder was used as a source of protein in the first three tests conducted. In all later trials, cottonseed meal alone and in combination with skim milk powder was fed as the protein concentrate.

The general plan of these feeding trials consisted in allowing the calves a full feed of whole milk, which was at the rate of 1 pound of whole milk to each 10 pounds of liveweight for the first 20 to 45 days, weaning them entirely from milk 10 to 15 days later (depending on the group they were in). Dry grain rations and hay were kept before the calves at all times when they were in the barn and oat hay was before them when they were turned in the lot. With the exception of a very few days these calves were in the open lot from 9:00 to 2:00 each day. This open lot consisted of a quarter of an acre, in which the calf barn is located. Although there was some grass in this lot, it was not considered of consequence except with groups 5, 7, and 8, which were born in late winter or early spring, and therefore, consumed some grass from April till June when they went off test. In addition to the hay rack in the lot, there was a water trough and a salt box.

Legume hay was fed in hay racks, or mangers, in the barn at 2:00 p. m. Oat hay was kept in the racks in the lot. From the time the full milk feeding was stopped until the calves were weaned, the whole milk was gradually replaced with warm water. This water was warmed to approximately body temperature by running a steam hose in a 10-gallon can of water at feeding

Table 72. Concentrate mixtures fed during experiment as supplement to limited milk, South Carolina, 1929-1933

Ration number	1	2	3	4	5	6
Ground yellow corn, lbs.	40	39	39	34	39	34
Ground oats, lbs.	44	40	40	35	40	35
Haddock fish meal, lbs.	15		10	----	----	----
Menhaden fish meal, lbs.		10	----	----	----	----
Skim milk powder, lbs.		10	10	10	----	20
Cottonseed meal, lbs.			----	20	20	10
Salt, lbs.	1	1	1	1	1	1

time. Milk was fed twice per day and water feeding was continued on this same plan at the rate of 1 gallon per feeding, or 2 gallons per day, for the period indicated in table 72.

Table 73. Feed consumption and growth of dairy heifers for six-month periods, South Carolina, 1929-1933

Group No.	1	2	3	4	5	6	7	8
Age weaned from milk, days	60	59	56	60	60	30	45	50
Whole milk consumed, lbs.	435	400	383	457	440	231	284	447
Percent normal weight	95.5	95.7	91.3	106	99.6	89.3	82.1	92.7
Percent normal height	98.3	98.6	96.2	99.9	99.2	97.4	95.3	97.7
Season test started*	W	S	F	F	S	F	W	W

*Groups started in winter and spring received some grazing in addition to barn feeding. W—Winter, S—Spring, F—Fall.

Reference: South Carolina Agricultural Experiment Station Bulletin 293, "Raising Dairy Calves by a Limited Milk Feeding Plan," pages 6, 7, and 8, tables 2 and 3, Clemson, South Carolina, January 1934.

Milk Substitutes for Calves

Conducted by: Massachusetts Agricultural Experiment Station.

Conducted at: Amherst, Massachusetts.

Period: 1924-1929.

Purpose: To compare the feeding of skim milk powder and buttermilk powder alone and in combination with other feeds to dairy calves as substitutes for whole milk.

Procedure and conditions: Practically all calves used in this work have been Holsteins, the majority of them being natural increase of the station herd, although some were bought outside. At least five calves have been used for each separate experiment.

The calves in the station herd are left with the dams from 24 to 48 hours, depending on the vigor of the calf. At the end of that time they are removed and taught to drink whole milk from a pail. Occasionally if the dam is a Jersey and known to give very rich milk, the colostrum is milked out and some of it is given to the calf from a pail. This obviates the possibility of gorging and indigestion which is sometimes seen in calves from high testing cows. Calves bought from outside are secured as soon as possible after they are dropped, the average age being 3 to 4 days.

Whole milk only, of rather low fat content, is fed for the first week, usually not more than 6 quarts, although occasionally with large and vigorous calves as many as 8 quarts have been fed. The process of weaning from whole milk is begun at from 1 week to 10 days of age, 1 quart of the whole milk being withheld and a quart of liquid made with warm water and the material in question given in place of it. This substitution is gradually increased (usually a quart at a time every second day) until the calf is getting only 2 quarts of whole milk, the balance being the substitute. The amount of liquid fed is increased gradually until at 3 weeks of age or thereabouts the calf is getting 9 quarts daily. Two quarts of whole milk are fed daily until 4 weeks of age, and 1 quart daily until 6 weeks of age, at which time the process of weaning from whole milk is completed. Except in some very recent experiments, liquid feeding has been continued until 4 months of age.

The calves are taught to eat good quality rowen and a dry grain mixture as early as possible. With the rowen, this is done by keeping a small handful in a manger before them all the time, at first removing each day what they do not clean up, so that it will not become stale. It is surprising how early they will nibble at it and relish it if care is used not to give them too much. The grain is rubbed on their noses or placed in the bottom of the pail when they finish drinking, and as soon as they acquire a taste for it a little is kept before them constantly. The mixture which has been fed in connection with this work is composed of:

Ground oats	30 pounds
Red dog flour	30 pounds
Corn meal	25 pounds
Linseed meal	15 pounds
Total	100 pounds

Half a pound of salt is added to each 100 pounds of the grain. This contains approximately 17 percent of protein, 5 percent of fat, and not more than 6 percent of fiber.

The object in all of the trials was to encourage the calves to eat as much rowen as possible and of the grain mixture up to 3 pounds daily. Naturally when a full liquid diet was continued until 4 months of age the consumption was less than when liquid was supplied in a restricted amount.

The experimental feeding period is continued to the end of the fourth month, at which time the calves are gradually weaned entirely from pail feeding.

The calves are fed three times a day at regular feeding hours, and the liquid is always fed warm, at about body temperature. The amount of skim milk powder or buttermilk powder used in making the liquid is 3½ ounces to 1 quart of water, or to express it in another way, 1 pound to 4½ quarts of water.

Table 74. Summary of calf feeding experiments in Massachusetts, 1924-29

	Liquid skim milk	Skim milk powder	Skim milk powder	Skim milk powder	Skim milk powder	Skim milk powder	Butter milk powder	Butter milk powder	Diluted whole milk
Whole milk, qts.	131	80	83	161	138	167	154	152	329
Skim milk, qts.	1,091								
Powdered skim milk, lbs.		250	255	123	161	164			
Powdered buttermilk, lbs.							193	120	
Grain, lbs.	88	79	119	115	216	207	125	106	166
Rowen, lbs.	196	140	163	258	141	170	207	203	248
Average daily gains, lbs.	1.75	1.43	1.41	1.37	1.61	1.70	1.64	1.10	1.28
Weight at four months, lbs.	303	264	262	257	287	297	290	224	246

Reference: Massachusetts Agricultural Experiment Station Bulletin 253, "Milk Substitute for Calves," pages 115, 116, 120, table 2, Amherst, Massachusetts, July 1929.

Self-Feeding versus Hand-Feeding with Dairy Calves

Conducted by: Montana Agricultural Experiment Station.

Conducted at: Bozeman, Montana.

Period: Two 67-day periods in 1921 and 1922.

Purpose: To compare the effects of hand-feeding with those of self-feeding dairy calves.

Procedure and conditions: Two feeding trials were conducted in 1921 and 1922 in which two lots of calves were fed, one by hand in the usual manner and the other self-fed on grain. The self-feeder was of a type similar to those used for feeding pigs. Both lots had free access to a good grade of mixed hay and were fed equal amounts of skim milk. The hand fed calves received what grain they would clean up in a few minutes twice a day. In the first feeding trial the grain mixture consisted of five parts ground barley, four parts oats, and one part linseed oil meal. There were four calves in each lot and the test continued for 67 days.

For the first 2 days of the experiment, self-fed calves consumed a large amount of grain. On the third day three of the calves suffered from indigestion. Following this attack they resumed eating grain. While no further symptoms of indigestion were observed, these calves apparently did not do well, as indicated by the roughness of hair and unthrifty appearance as contrasted with the hand-fed animals. It was also observed that the self-fed calves gave more trouble from sucking one another than did the hand-fed calves that were fed grain immediately after the milk.

The second feeding trial was conducted on the same plan except that a different grain mixture composed of four parts of ground barley, four parts of whole oats, and two parts of wheat bran was used. Average results of the two experiments are shown in table 75.

Table 75. Self-feeding versus hand-feeding for dairy calves, Montana, 1921-1922 average

	Lot 1 Hand-fed	Lot 2 Self-fed
Number calves per lot	4	4
Number of days on trial	80	80
Average age at beginning of trial	77.9	74.5
Average daily gains per calf, lbs.	2.02	1.89
Average daily feed consumption:		
Hay, lbs.	3.85	2.44
Grain, lbs.	3.76	5.02
Skim milk, lbs.	12.71	12.71

Reference: Montana Agricultural Experiment Station Bulletin 282, "Feeds for Dairy Cattle," pages 14, 15, and 16, tables 10 and 11, Bozeman, Montana, December 1933.

Method of Feeding Dairy Heifers During the Winter Period

Conducted by: West Virginia Agricultural Experiment Station.

Conducted at: Morgantown, West Virginia.

Period: 1921-22, 1923-24 and 1923-25.

Purpose: To compare the effects of self-feeding and hand-feeding dairy heifers on feed consumption and growth.

Procedure and conditions: The experiment was conducted for the three periods 1921-22, 1923-24, and 1923-25. Two groups of heifers were used during each trial. One group was fed during the winter months a ration as near to its requirements as was practicable and in some cases even slightly below requirement, as stated by the Morrison Feeding Standard, while the animals in the other groups were fed all the roughage they would consume and were given access to a hopper which was kept filled with corn meal, wheat bran, and linseed oil meal. As soon as pasture season arrived (usually about May 5 to 10) all the heifers from both groups were turned on a large pasture (about 75 acres). The pasture was fairly good until late summer, when it would become quite short and dry. With the early fall rains the pasture would improve and would again give fair yield until late fall (usually about November 20 to 25), after which the heifers would be put into the stable.

In the stable the heifers were housed in large open sheds. They were not tied, but were allowed to go and come as they desired. The self-fed groups were fed concentrates in the self-feeder and were allowed free access to roughage. Salt and water were kept before the animals of each group at all times.

Each group was weighed and the height at the withers was measured every 2 weeks during the winter months and at monthly intervals during the summer months.

Feeding during first trial. In trial 1, which started on November 24, 1921, each group was fed daily 6 pounds of alfalfa hay per head and 3 pounds of corn silage for each 100 pounds of liveweight. In addition group 1 was allowed free access to a hopper filled with wheat bran, corn meal, and linseed oil meal. On December 13 the amount of silage fed to group 1 was decreased to 1½ pounds per hundredweight, which was as much as they would consume.

The heifers in group 2 were fed an average of 5 pounds per head daily of a grain mixture consisting of 300 pounds of wheat bran, 200 pounds of corn meal, and 150 pounds of linseed oil meal.

In trial 1, group 1 included three Holsteins and one Jersey; group 2, three Holstein and one Guernsey. The heifers were on pasture 203 days and were fed for a winter period of 158 days.

Feeding during second trial. In trial 2, begun December 1, 1923, each group was started with 30 pounds of mixed hay and 30 pounds of corn silage per day. This amount was varied according to the appetites of the heifers. The animals in the self-fed group would not consume this amount, while those in the hand-fed group consumed a larger amount as they grew older.

As in trial 1, group 3, the self-fed group, was allowed free access to a hopper filled with corn meal, linseed oil meal, and wheat bran, while group 4, the hand-fed group, was fed a ration consisting of 300 pounds of wheat bran, 200 pounds of corn meal, and 150 pounds of linseed oil meal. This mixture was fed in amounts so that the heifers were receiving nearly a balanced ration according to the feeding standards. Group 1 included four Holsteins and one Guernsey and group 2 the same. The heifers were fed for a winter period of 156 days and then turned on pasture for 194 days.

Feeding during third trial. Trial 3 was started December 21, 1923, although one calf in each group was not put in the experiment until January 16, 1924. This experiment continued throughout 2 years. The calves during the first feeding period were much younger than those in trials 1 and 2. The calves in both groups had been fed skim milk up until the time they were put on the experiment and for some time afterward. However, just as soon as they became accustomed to eating grain and roughage, the milk was discontinued.

Both groups were fed all the corn silage and alfalfa hay they would eat. For some time soybean hay was fed instead of alfalfa hay. Group 5 was allowed free access to a hopper filled with corn meal, wheat bran, ground oats, and linseed oil meal, while group 6 was fed, according to its requirements, a ration consisting of 300 pounds of corn meal and 100 pounds each of wheat bran, ground oats, and linseed oil meal. Group 1 included two Holsteins, one Jersey, and one Ayrshire. Group 2 included two Holsteins and two Jerseys. These calves were fed for a winter period of 117 days and then turned on pasture for 198 days, after which they were fed for another 169-day winter period and then turned on pasture for 198 days.

Table 76. Self-feeding versus hand-feeding with dairy heifers, summary 3 trials, West Virginia, 1921-25

	First trial 1921-22		Second trial 1922-23		Third trial 1923-25	
	Group 1 Self-fed	Group 2 Hand-fed	Group 3 Self-fed	Group 4 Hand-fed	Group 5 Self-fed	Group 6 Hand-fed
First winter period, days	----	----	----	----	117	117
Number heifers	----	----	----	----	4	4
Av. gain in weight, lbs.	----		----	----	270.25	139.0
Av. gain per day, lbs.	----	----	----	----	2.31	1.19
Lbs. of grain per lb. gain	----	----	----	----	4.64	2.07
Height at withers gained, cm.	----	----	----	----	18.45	12.25
First summer period, days	----	----	----	----	198.0	198.0
Av. gain in weight, lbs.	----	----	----		100.0	120.5
Av. gain per day, lbs.	----	----	----	----	0.51	0.61
Av. height at withers gained, cm.	----	----	----	----	5.75	5.95
Total period first year, days	----	----	----	----	315.00	315.00
Av. gain in weight, lbs.	----	----	----	----	370.25	259.50
Av. gain per day, lbs.	----	----	----	----	1.18	0.82
Grain per lb. gain, lbs.	----	----	----	----	3.39	1.10
Height at withers gained, cm.	----		----	----	24.2	18.2
Winter period, days	158.0	158.0	156.0	156.0	169.0	169.0
Number heifers	4.0	4.0	5.0	5.0	4.0	4.0
Gain in weight, lbs.	298.8	205.0	326.3	193.2	270.6	72.5
Gain per day	1.89	1.30	2.09	1.24	2.19	0.43
Grain per lb. gain, lbs.	7.29	3.83	7.2	3.1	7.69	6.03
Height at withers gained, cm.	10.0	10.0	14.0	9.0	13.2	5.4
Summer period, days	203.0	203.0	194.0	194.0	198.0	198.0
Gain in weight, lbs.	60.2	177.5	165.9	218.3	14.9	143.7
Gain per day, lbs.	0.30	0.87	0.83	1.13	0.075	0.726
Height at withers gained, cm.	4.5	6.5	4.3	8.4	0.2	4.5
Total period, days	361.0	361.0	350.0	350.0	376.0	376.0
Gain in weight, lbs.	358.8	382.5	492.2	411.5	385.5	216.2
Gain per day, lbs.	0.99	1.06	1.41	1.18	1.05	0.59
Grain required per lb. gain	6.07	2.06	4.97	1.45	7.39	2.02
Height at withers gained, lbs.	14.5	16.5	18.4	17.4	13.4	9.9

Reference: West Virginia Agricultural Experiment Station Bulletin 232, "Wintering Dairy Heifers by Means of Self-Feeder," pages 4, 5, 6, 7, 8, and 9, tables 8, 9, and 10, Morgantown, West Virginia, April 1930.

Feeding Dairy Cows Prior to Calving

Conducted by: Maryland Agricultural Experiment Station.
Conducted at: Beltsville, Maryland.
Period: 57 days for heavy feeding and 65 days for light feeding, 1928.

Table 77. Effect of heavy and light feeding of cows before calving upon the production of milk and butterfat after calving, Maryland, 1928

Cow	Breed	Plane of feeding	Age of cow when feeding experiment started		Period of feeding	Time cow was dry	Condition at beginning and end of feeding experiment*		First weight of cow taken after calving	Production for 90 days after calving		
							Beginning	End		Milk	Butterfat	
			Years	Months	Days	Days	Rating	Rating	Pounds	Pounds	Percent	Butterfat
444	Jersey	heavy	9	5	45	65	65	65	1,002	2,508.9	4.81	120.61
		light	8	6	61	38	65	55	907	1,881.4	4.85	91.21
485	Jersey	heavy	9	9	49	57	75	80	932	3,731.2	5.10	190.37
		light	8	8	61	60	75	75	950	3,729.8	5.00	186.62
A-20	Grade	heavy	4	9	74	83	70	85	1,211	3,068.6	3.37	103.31
	Holstein	light	5	9	67	89	75	75	1,245	3,259.4	3.74	121.79
A-14	Grade	heavy	5	6	60	129	75	80	1,134	3,705.8	3.38	125.34
	Holstein	light	6	5	63	86	75	75	1,163	4,024.4	3.50	140.92
436	Jersey	heavy	9	5	57	63	85	85	930	2,139.8	4.24	90.70
		light	10	10	82	255	80	85	1,015	2,671.3	4.57	122.02
411	Jersey	heavy	11	5	59	126	90	85	1,012	2,331.5	4.55	106.14
		light	10	5	68	123	85	85	1,030	2,299.3	4.22	96.95
480	Jersey	heavy	7	8	62	70	85	85	1,041	2,410.7	5.67	136.71
		light	6	7	66	77	85	85	1,022	1,894.7	6.10	115.53
438	Jersey	heavy	9	6	70	62	75	75	1,079	1,781.1	5.37	95.61
		light	10	7	73	134	75	70	1,061	2,628.6	6.31	165.85
455	Jersey	heavy	8	0	42	138	70	75	787	2,179.1	4.71	102.70
		light	9	1	51	96	70	75	846	2,507.2	4.27	106.98
277	Holstein	heavy	7	2	51	61	60	60	1,286	4,163.9	3.54	137.37
		light	6	3	58	45	80	80	1,180	5,053.0	3.59	181.17
	Average	heavy	...	...	57	85	75.0	77.5	1,041.4	2,802.1	4.35	121.89
		light	...	...	65	100	76.5	76.0	1,041.9	2,994.9	4.44	132.90

*See test for explanation of rating.

Reference: U.S.D.A. Miscellaneous Publication 130, "Feeding and Management Investigations," pages 10, 11, and 12, table 6, Beltsville, Maryland, 1928.

Purpose: To compare the relative effects of heavy and light feeding before calving on the production of dairy cows after calving.

Procedure and conditions: In this experiment it was intended that the cows should be put in a good state of flesh by feeding them 12 pounds of grain per cow per day for an average of 2 months previous to calving, in order to compare their production with that of the same cows when put in only a medium state of flesh before calving, by feeding 4 pounds of grain a day for a similar period. The grain mixture used in heavy feeding was 8 pounds of hominy feed, 3 pounds of wheat bran, and 1 pound of old-process linseed meal; that used in light feeding was 3 pounds of wheat bran and 1 pound of old-process linseed meal. All of the cows received either pasture or all the alfalfa hay and silage they would eat.

At the time experimental feeding was started and also at the time of calving the condition of each cow was observed. This was expressed as a rating, with 100 as very fat and 70 as a medium state of flesh, or what would be termed good milking condition. Weights taken on the first, second, and third days of each month also helped to show the condition of the cow after calving. The data for 10 cows which had comparable periods of heavy and light feeding are given in table 77.

Vitamin D in the Nutrition of the Dairy Calf

Conducted by: Wisconsin Agricultural Experiment Station.

Conducted at: Madison, Wisconsin.

Period: June 6, 1930 to March 13, 1931; 280 days.

Purpose: To compare the growth of dairy calves fed a ration without vitamin D with that of calves fed plenty of vitamin D.

Procedure and conditions: Twenty-four grade Holstein heifer calves were purchased, divided into six lots, made as nearly equal as possible considering age, weight, condition, and probable outcome, and were started on experiment June 6, 1930. At this time they averaged 21 days of age.

Lot 1 received a basal ration of:

Yellow corn meal	50.0 lbs.
Corn gluten meal	20.0 lbs.
Linseed meal	20.0 lbs.
Wheat middlings	6.5 lbs.
Calcium flour ($CaCO_3$)	3.0 lbs.
Salt	0.5 lbs.

Ten pounds of ground wood shavings were mixed with 90 pounds of the above mixture to add roughage. The calves were started on whole milk, shifted gradually to skim milk by the end of the fourth week, and fed up to 16 pounds of skim milk daily until the ninth week when the allowance was reduced gradually until no milk was fed after the tenth week.

Lot 2 received the basal ration and milk feeding as in lot 1. Cod-liver oil, 20 cc. per calf daily, was added to the milk during the milk feeding period, after which it was poured over the concentrates.

Lot 3 was fed the same as lot 2 except aerated cod-liver oil was used.

Lot 4 received the basal ration and milk feedings as in lot 1, plus sunlight exposure every day in summer and every sunny day in fall and winter.

Lot 5 received the basal ration and milk feeding as in lot 1. Canned tomatoes, 125 cc. per calf daily, were fed with the milk until it was removed, when the tomatoes were poured on the grain ration. Sunlight exposure was provided as in lot 4.

Lot 6 was given the basal ration as in lot 1. Canned tomatoes, 125 cc. per calf daily, were fed in the milk until it was discontinued, when the tomatoes were poured on the daily grain allowance.

The aerated or oxidized cod-liver oil was prepared by placing 2 liters of the oil in a wide mouthed bottle in an electric oven held at 100° C. and bubbling air through the oil by means of suitable tubes connected with a suction pump. This treatment was continued for 24 hours, which was considered ample to destroy the vitamin A present, as shown by the work of Hopkins, McCollum, and Steenbock. The tomatoes were prepared by putting a restaurant brand of canned tomatoes through a potato ricer which removed the most fibrous portions of the pulp and most of the seeds.

No difficulty was experienced in getting the calves to consume the ration and supplements. The calves were kept in individual box stalls approximately 5 x 10 feet. Individual feed consumption and body weight records were kept for each calf. For the sunlight exposure lots 4 and 5 were turned outside in a small cinder covered paddock adjacent to the stable. A small shed roof provided shade at one corner of the north side of the paddock which permitted the calves to get out of the direct sunlight if they so desire during the hottest weather. No feed was supplied in this paddock, but drinking water was available to the calves. They were fed in their respective individual stalls indoors and turned out after the morning feeding at about 9 to 9:30 a. m., and returned to their stalls for the evening feed at about 5 p. m. In inclement weather they were kept indoors.

Table 78. Average weights, gain and feed consumption of calves, Wisconsin, 1930-31

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
From June 6, 1930 to March 13, 1931, 280 days	Control	Cod-liver oil 20 cc*	Oxidized cod-liver oil 22 cc*	Sunlight	Sunlight, tomatoes 125 cc.	Tomatoes 125 cc.
Av. wt. at beginning, lbs.	112	114	112	109	114	114
Av. weight at end, lbs.	312	655	654	557	576	287
Av. daily gain, lbs.	.71	1.93	1.93	1.59	1.65	.62
Average ration:						
Concentrates, lbs.	4.6	7.5	7.5	7.5	6.6	4.1
Wood shavings, lbs.	.50	.83	.83	.72	.76	.45
Whole milk, lbs.	.05	.05	.06	.06	.06	.06
Skim milk, lbs.	3.1	3.1	3.1	3.1	3.1	3.0
Cod-liver oil, cc.	----	22.0*	22.0*	..	----	..
Canned tomatoes, cc.	----	...	----	..	125.0	125.0

*Average of 20 cc. cod-liver oil for 36 weeks, 40 cc. for the last 4 weeks.

Reference: Wisconsin Agricultural Experiment Station Research Bulletin 115, "Vitamin D in the Nutrition of the Dairy Calf," pages 3, 4, and 5, table 1, Madison, Wisconsin, February 1933.

Ground Soybeans and Linseed Oil Meal for Dairy Calves

Conducted by: Indiana Agricultural Experiment Station.
Conducted at: Lafayette, Indiana.
Period: 360 days beginning May 1929.
330 days beginning September 1930.

Purpose: To compare ground soybeans and linseed oil meal for dairy calves.

Procedure and conditions: Two trials have been completed in which eight calves have been raised on ground raw soybeans as a protein supplement and eight calves on linseed oil meal as a protein supplement. The first trial began in May 1929 and was continued for a period of 360 days. The second trial began in September 1930, and continued for a period of 330 days. Eight calves, divided into two groups of four calves each, were used in each trial. In the first trial each group contained two Ayrshires, one Holstein, and one Jersey, whose average age at the beginning was 64 days. The groups in the second trial contained two Ayrshires and two Holsteins each, whose average age at the beginning of the trial was 89 days. The groups were made as uniform as possible as to age, size, and weight.

The calves received whole milk until 90 days of age, when milk feeding was discontinued for the reason that it might mask the true feeding value of the linseed oil meal and the ground soybeans as protein supplements to the grain rations. The milk was fed at the rate of 1 pound of milk for each 6 pounds of liveweight of the calf, with a maximum amount of 10 pounds of milk per calf per day.

One group of calves received a grain ration containing linseed oil meal, and the other group received a grain ration with ground soybeans. On the basis of chemical analyses of the individual feeds used in the grain mixtures, the rations were made up to furnish approximately the same percentage of total protein and total digestible nutrients. Periodic analyses of the grain mixture showed them to contain practically the same amounts of protein. The average protein content of the linseed oil meal ration was 16.20 percent, and of the soybean ration 16.35 percent. The ingredients of the two grain mixtures are given in the following table:

Kinds and amounts of ingredients in the grain mixture

	Linseed oil meal ration	Ground soybean ration
Ground corn	300	318
Ground oats	300	350
Wheat bran	300	300
Linseed oil meal	200	----
Ground raw soybeans	----	182
Salt	10	10

In the first trial both groups of calves received timothy hay for the first 90 days and then were fed alfalfa hay during the remainder of the trial. In the second trial the calves were fed alfalfa hay during the entire period.

The calves consumed sufficient amounts of hay and grain to keep them in good growing condition. They were fed twice daily and accurate records kept of the feeds consumed by each calf. The calves were kept in dry lot and did not have access to pasture at any time during the experiment.

The calves were weighed at the beginning of the experiment and every 10 days thereafter, weights being taken for 3 successive days and an average of the three weights recorded as the true weight of the individual at that time. Their heights at withers were taken at the beginning of the trial and every 30 days thereafter. Careful observations were made for digestive disorders and any other abnormal conditions of the indivdual calves used in these trials.

Table 79. Feeds consumed, gains made in the weight and height by the calves in the experiment

	Trial 1 1929-30		Trial 2 1930-31		Average 2 trials	
	Linseed oil meal	Ground soybeans	Linseed oil meal	Ground soybeans	Linseed oil meal	Ground soybeans
No. calves	4	4	4	4	4	4
No. days	360	360	330	330	345	345
Milk, lbs.	1,225.0	1,081.5	526.30	730.50	875.75	912.50
Grain, lbs.	6,092.5	5,933.75	5,805.50	5,730.00	5,949.1	5,841.90
Hay:						
Timothy, lbs.	632.25	599.50				
Alfalfa, lbs.	4,857.00	4,837.00	6.080.5	6,080.5		
Total hay, lbs.	5,489.25	5,458.50	6,080.5	6,080.5	5,785.6	5,768.50
Total dry matter, lbs.	10,660.40	10,466.70	10,879.3	10,827.5	10,789.85	10,657.10
Total gain wt., lbs.	1,701.00	1,637.00	1,805.0	1,865.0	1,753.0	1,751.0
Av. daily gain, lbs.	1.18	1.14	1.36	1.41	1.27	1.27
Lbs. dry matter per lb. gain	6.27	6.41	6.02	5.81	6.14	6.09
Total gain height	54.2	53.1	52.4	53.6	53.3	53.35
Av. monthly gain in height, in.	1.129	1.108	1.191	1.218	1.158	1.59

Reference: Indiana Agricultural Experiment Station Bulletin 354, "Ground Soybeans and Linseed Oil Meal for Dairy Calves," pages 4, 5, and 6, tables 1 and 2, Lafayette, Indiana, November 1931.

Feed Requirements for Raising Different Breeds of Dairy Heifers to Two Years of Age

Feed calculations are based on whole milk to 3 weeks with a gradual change to fresh skim milk during the fourth week and average to good hay cut fairly early with the retention of most of its leaves and some green color. Average total digestible nutrient values used for feeds were: Whole milk 16.2 percent, fresh skim milk 8.6, grain 75.0, and hay 50.0 percent. Feed substitutions can be made on the following basis: 3 pounds of silage (made with little or no wilting), 5½ of carrot or rutabagas, 6 of turnips, 7 of mangels, 2 of sweetpotatoes, 2 of fodder (including uneaten portion), or 0.7 lbs. of grain are equal to 1 pound of hay. One and one-half pounds of hay, 8 of carrots or rutabagas, 9 of turnips, 10 of mangels, 3 of sweetpotatoes, or 9 pounds of fresh skim milk are equal to 1 pound of grain.

Table 80. Summary of feed requirements for normal growth of dairy heifers from birth to 2 years in terms of milk, grain, and hay*

	Breeds		
Pounds of feed per animal	Ayrshire	Guernsey	Jersey
Milk and skim milk	2,252	2,190	2,007
Grain	1,946	1,946	1,925
Good hay equivalent	6,868	6,422	6,083
Total digestible nutrients	5,102	4,872	4,664

*Calculated from Ragsdale and Fohrman-Swett growth data (table 7, p. 625) and nutrient requirements for growth based on Gullison-Eckles data (table 9, p. 627). Ayrshire nutrient requirements per pound of gain are based on Holstein-Friesian data and Guernsey requirements are based on Jersey data.

Reference: U. S. Department of Agriculture Yearbook Separate, "Practical Feeding and Nutritional Requirements of Young Dairy Stock," Reprint of pages 597-638, Yearbook of Agriculture, 1939.

Improving the Dairy Herd by Use of Purebred Bulls

Conducted by: Iowa Agricultural Experiment Station.

Conducted at: Ames, Iowa.

Purpose: To compare the production of dairy cows to that of their dams when purebred and scrub bulls are used.

Procedure and conditions: The foundation animals used in this experiment consisted of 13 head of scrub females and 1 scrub bull. The scrub cows varied in age from heifer calves to old matured cows. Purebred bulls from the experiment station were bred to the scrub cows. The scrubs were purchased from an isolated region of Arkansas. Available records revealed that no purebred bulls had been used in that section of Arkansas. These scrubs showed very poor dairy characteristics.

The purebred bulls of the station were bred on the scrub cows and their off-spring and careful records kept to determine what improvements could be made in increasing production. In-breeding was practiced only twice and one of the calves came blind and was destroyed and the other was satisfactory. The purebred bulls were not extremely high-priced bulls, but some of them made very high increases in the production records of their daughters over the daughter's dams. The scrub and the grade cows received the same housing, feeding,

Table 81. Production of three generations of Holstein grade cows, Iowa

Cow in line of descent	Number of lactations	Av. fat produced in lbs.	Increase in lbs. of fat		Number of generations
			Over dam	Over scrub	
52 Scrub	7	169	..	...	....
69	5	282	113	113	1
281	2	247	65	178	2
485	4	439	92	270	3
52 Scrub	7	169	....	. .	
69	5	282	113	113	1
373	2	303	21	134	2
504	1	402	99	233	3
56 Scrub	3	193	....	.	....
77	6	266	73	73	1
282	1	402	136	209	2
399	3	390	—12	197	3
60 Scrub	6	178	....	....	....
207	4	288	110	110	1
311	3	491	203	313	2
577	1	439	—52	261	3

The indenting of the number in column, "Cow in Line of Descent" represents the different generations. For example, cow 69 is a half-breed Holstein out of scrub cow 52, cow 281 is the three-fourths-breed Holstein out of half-breed cow 69, and cow 485 is a seven-eights-breed Holstein out of cow 281.

Table 82. Production of two generations of Jersey grade cows, Iowa

Cow in line of descent	Number of lactations	Av. fat produced in lbs.	Increase in lbs. of fat		Number of generations
			Over dam	Over scrub	
31 Scrub	7	168	....	....	....
174	3	264	96	96	1
245	1	287	23	119	2
53 Scrub	7	234	....	.	....
213	4	236	2	2	1
398	6	347	111	113	2
60 Scrub	6	178	....		.. .
241	2	349	171	171	1
348	5	319	—30	141	2

care, and management that purebred cows received at the same station. These experiments were run from two to three generations.

Table 83. Scrub bulls versus purebred bulls, Iowa
Influence of scrub bull

Dams				Daughters*			
Cow number	Number of lactations	Pounds of milk	Pounds of fat	Cow number	Pounds of milk	Pounds of fat	Increase over dams
7	3	2,368	138	59	3,747	180	42
8	3	2,339	124	58	3,034	153	29
31	7	3,463	168	60	3,313	178	10
Average		2,723	143		3,365	170	27

*The increase of daughters sired by scrub bulls was due mostly to influence of environment. They were raised at the Station and received better care and treatment than their dams did, therefore, developed into better cows.

Table 84. Influence of purebred bulls, Iowa

Sire	Purebred bulls used		Dams	Daughters	Increase over dams
	Rank	Breed	Lbs. of fat	Lbs. of fat	Lbs. of fat
F	2	Holstein	166	262	96
G	1	Holstein	266	486	220
H	8	Holstein	280	358	78
I	9	Holstein	335	399	64
J	14	Holstein	440	382	—58
K	5	Jersey	193	282	90
L	11	Jersey	264	287	23
M	13	Jersey	349	319	—30
N	4	Jersey	236	347	111
Average for 9 cows					65

Reference: Iowa Agricultural Experiment Station Bulletin 251, "Influence of Environment and Breeding in Increasing Dairy Production," Ames, Iowa.

Improving the Dairy Herd by Use of Good Bulls

Conducted by: Oklahoma Agricultural Experiment Station.

Conducted at: Stillwater, Oklahoma.

Period: 1923-26.

Purpose: To compare the production of scrub dairy cows to that of their daughters when bred to purebred bulls.

Procedure and conditions: In 1923, twelve scrub cows were purchased to be used in a breeding experiment to demonstrate the constant use of purebred sires in building a dairy cow from a foundation of common scrub cows.

Seven of the first-cross heifers, six of the second-cross, and two of the third-cross have completed one or more lactation periods. The records were calculated to mature age and all production was made in 305 days or less. Only 5 scrub cows were used in the test because only this number had offspring that could be used in the experiment.

In this experiment, there was no selection and the improvement made has been only by the continued use of purebred sires.

Table 85. Comparison of the production of scrub cows with that of their dams by continued use of purebred sires, Oklahoma, 1923-36

	Scrubs	F_1 Grades	F_2 Grades	F_3 Grades
Production in pounds				
Milk	4,908.1	7,501.3	9,084.8	9,452.4
Fat	213.4	327.0	384.9	399.4
Number of cows	5	7	6	2

DISEASES AND PARASITES OF DAIRY CATTLE

Losses of cattle due to diseases and parasites amount to many thousands of dollars in Mississippi each year. Often the losses due to diseases and parasites represent the profit that a producer would have made if the losses had been prevented. In many instances cattle are lost without the producer knowing the cause. Losses of this kind are dangerous, in that an entire herd may become infected with a disease or parasite before the producer realizes it.

Dairy producers should be able to recognize and should know how to treat the more common diseases and parasites of cattle. Farmers so equipped will many times save a veterinarian's bill as well as the value of the dairy cattle. This knowledge is also important because of the scarcity of veterinarians.

In presenting information on milk production it seems important that information on the more common diseases and parasites should be included.

Diseases

There are a number of cattle diseases. The more common diseases in Mississippi are blackleg, white scours, bovine mastitis, milk fever, shipping fever, anthrax, Bang's disease (infectious abortion), and infectious keratitis or pinkeye. Information is presented in this publication on the symptoms and treatment of these diseases.

Blackleg

Blackleg is an acutely infectious and usually fatal disease which attacks young cattle between 6 months and 2 years of age.

Usually the organism gains entrance into the body of the animal through small cuts or punctures in the skin; large cuts or open wounds are not favorable for growth of the organism. In some cases the organism may enter the body through abrasions in the mucous membranes of the tongue, mouth cavity, or throat.

Symptoms. The symptoms of blackleg are so characteristic that it is possible to recognize the disease easily. The first symptoms to be noted are high fever, loss of appetite, and a suspension of rumination, followed by great depression. Breathing becomes more rapid than normal. In most cases the animal has difficulty in moving about, and it frequently lies down. Rapidly developing swellings or tumors in the tissues under the skin are characteristic. They may appear on the neck and shoulders, beneath the breast, and on the flanks and thighs, and in some instances they appear on the gums, the base of the tongue, and the wall of the pharynx. The tumors are accompanied by severe febrile symptoms. At first small and painful to the touch, they rapidly increase in size and may cover a considerable part of the body. Upon pressure the tumors make a peculiar crackling sound which is due to the collection of gas formed by the causative micro-organisms.

As the swellings increase in size, the symptoms become more intense. The temperature may reach 107° F., and the respiration may increase to 140 or more a minute. The animal is unable to rise, the extremities become cold and the temperature usually falls and may become subnormal shortly before death. Violent convulsions and trembling of the muscles are noted before death. Although there are some recoveries, death generally occurs in 12 to 36 hours after the first appearance of the disease.

The carcass of an animal dead from blackleg soon becomes distended by gas, partly through fermentation in the gastro-intestinal tract and partly through the formation of gas in the tissue under the skin. Marked distention is noted in the region of the blackleg tumors and where there is loose tissue, especially between the shoulder and chest and on the outer surface of the hindquarters. In many instances this distention causes the legs on the upper side to stand out straight from the body. Shortly after death a dark, blood-colored, frothy discharge flows from the nostrils and anus. An incision made through the skin into the affected muscle tissue fails to demonstrate any decomposition but it is possible to detect a characteristic sweetish-sour odor.

The skin covering the blackleg tumors is affected with dry gangrene. The distended muscles, which are easily torn, are dark brown or black, and the spaces surrounding them are filled with bloody liquid and gas. The blood in the badly affected parts of the body is thick and charged with gas and has a disagreeable odor. In the remaining parts of the carcass the blood is normal and coagulates easily after death, forming a solid clot. Hemorrhages are found on the heart and lungs. The spleen is always normal, but congestion is noted on the liver.

Thus it may be seen that a post-mortem examination should serve to distinguish blackleg from other diseases. Nevertheless, though a diagnosis may be made at autopsy, it is sometimes advisable to send specimens from affected animals to the laboratory for a conclusive diagnosis.

Treatment and prevention. Medicinal treatment of animals has thus far proved unavailing. The only reliable and effective means known for protecting animals against blackleg is vaccination, which has been thoroughly tried and proved to be reliable.

Vaccines for protection against blackleg have been greatly improved in recent years. Those produced at the present time include blackleg bacterin, natural aggressin, cultural aggressin, cultural vaccine, and tissue vaccine. These vaccines are used extensively in the United States and give excellent results, as they confer immunity without producing any vaccination disease.

As vaccine is a preventative and not a curative agent, it is useless to vaccinate an animal after the symptoms of blackleg have developed. The immunity conferred by vaccination varies according to the kind of vaccine used and may last 12 to 18 months or longer.

When blackleg occurs on a ranch or farm it is of the utmost importance that owners of cattle in the district realize that every animal affected with the disease may be the means of propagating and disseminating the infection. Losses may not occur immediately on infected premises; in some cases they occur only after a lapse of years. It is recommended, therefore, that every effort be made to reduce the danger of infection by taking appropriate measures of disposal of all dead animals and with them the infection they carry. The carcass should be entirely destroyed by burning if this is possible. Otherwise a hole 6 feet deep should be dug and the body placed therein and well covered with quicklime before the earth is filled in. Any place where the animal was lying should be thoroughly sprinkled with a strong disinfectant, such as a solution of commercial lye and hydrated lime (2½ pounds of lye and 2½ pounds of lime in 8½ gallons of water).

The eradication of blackleg infection from pastures is difficult. In most cases it is impossible to pasture livestock on other land long enough for the infection to die out. It appears, therefore, that vaccination is the only practicable and effective means of protecting cattle against blackleg. If vaccine is used year after year to prevent the development of new cases over a long period, it is possible that the old infection will finally disappear.

Reference: 1942 Yearbook of Agriculture, "Keeping Livestock Healthy," pages 523-525.

White Scours (Infectious Diarrhea, or Acute Dysentery)

Acute dysentery, a condition commonly referred to as white scours, is an acutely contagious disease of young or newborn calves characterized by acute diarrhea and rapid exhaustion. The majority of the animals affected are very young, usually less than 5 days old. In severe outbreaks, the disease may spread to older calves.

Outbreaks of this disease may occur at any season of the year, but is most common in stabled animals during the fall and winter months. Infection may take place either through the navel cord or the digestive tract.

Symptoms of the disease vary somewhat in the individual cases. At birth the calf may appear normal, or occasionally it may be weak or dull, but in 48 to 72 hours, or later, a profuse, yellowish-white diarrhea with a very pungent and disagreeable odor develops. The animal usually appears dull and listless, the eyes may be drawn back in the sockets and lack luster. Stiffness of gait is not uncommon. The hair coat often appears rough and the skin dry. The abdomen will show a tucked-up or gaunt appearance in very young calves. Affected calves usually have a tendency to sleep most of the time and their appetite is very poor.

Treatment: Calves showing symptoms of the disease should be isolated. The feces should be destroyed and the stable disinfected. As soon as the disease is detected the following treatment may be used: (1) Drench the calves with 1 quart of bacillus acidophlus buttermilk. In some cases it may be necessary to repeat the dose, or (2) as soon as scours are detected give calf 2 ounces castor oil followed in 3 hours with 1 gram of sufa-guanadine for each 10 pounds body weight along with 300 to 400 cc. of warm water. If scours continue after 6 to 8 hours give ½ gram sulfa-guanadine for each 10 pounds of body weight along with 300 to 400 cc. warm water, or (3) if above treatments do not stop the disease a blood transfusion of 100 to 200 cc. given subcutaneously often proves very satisfactory.

Reference: 1942 Yearbook of Agriculture, "Keeping Livestock Healthy," page 537.

Bovine Mastitis

Bovine mastitis is an extremely dangerous disease of dairy cattle. Annual losses to the dairyman due to this disease are enormous because of loss of cows, decrease in milk production and poor quality of milk. In addition, certain human diseases may be contracted from using milk from affected cows.

Mastitis means the inflamation of the udder from any cause. There are two forms of disease, acute and chronic. The chronic form of the disease is more common. In acute attacks the affected quarter is reddened, swollen, hot and painful. The milk secretion is very much reduced, and varies from a watery blood-tinged fluid containing a few solid particles to yellow ropy material.

In the past acute attacks of mastitis were thought to be temporary, and it was believed that when the attack passed the recovery was complete. Actually, in most cases, the acute symptoms represent a flare-up of a chronic form already present in the quarter. Recovering from an acute attack usually means returning to the chronic state.

Mastitis is an infectious disease caused by certain kinds of bacteria entering the opening into the teat canal, traveling up the canal, and lodging in the milk cistern at the end of the teat, where they cause a mild or low-grade inflammation. The bacteria spread and finally the entire quarter is affected.

Bacteria causing mastitis may be caused by a number of different bacteria. Of greatest importance are the streptococci, including several species that are responsible for such diseases in man as scarlet fever and septic sore throat. Bacteria of these species do not tend to spread through the herd, but they may be carried from cow to cow on the milkers' hands or on the cups of the milking machine.

Next in importance as the cause of mastitis are staphylococci. There are several species of this bacteria. These bacteria usually cause the chronic form of the disease and are not likely to persist in the udder for as long as the streptococci do. Acute attacks may terminate in the death of the animal in staphylococcal mastitis.

Frequently other types of bacteria are found in occasional outbreaks of the disease. These types usually cause acute mastitis accompanied by systemic disturbance, and infrequently the animal dies.

Diagnosis: Early detection of the diseased cows is extremely important. Acute attacks of mastitis can be diagnosed readily by clinical tests, but the chronic form presents some difficulty. Tests that largely solve this problem are now available. Disposition of diseased animals is important in helping to keep the disease from spreading throughout the herd. There are methods of testing for this disease, (1) the strip-cup test and (2) the bromothymol-blue or thybromal test. In using the strip-cup test a few streams of milk are drawn from a quarter onto a fine-mesh wire screen immediately before the animal is milked. The appearance of clots or flakes or of watery or off-color milk on the screen is evidence of mastitis. This test should be used often in a dairy herd in order to check for this disease.

The bromothymol or thybromal test causes, when the dye solution is mixed with the milk, a variation in color. Milk from healthy animals is slightly acid, and when mixed with a few drops of the dye solution a pale-yellowish clear color results. Milk from diseased quarters is alkaline, and this is indicated by a green color when the dye is added. The more alkali the milk contains, the darker the shade of green when the dye solution is added. These two methods of testing are used for mastitis.

Prevention: Curative results are not entirely effective in controlling mastitis. Therefore, a program for controlling the spread of the disease in healthy cows is practical. Many times the disease is spread from diseased to healthy animals on the milker's hands or on the teat cups of the milking machine.

Affected cows should be separated from disease-free cows, and the disease-free cows should always be milked first. Complete segregation of the groups in separate barns with separate milkers is the most desirable arrangement. Infected cows should be sold as soon as they become unprofitable, or if they suffer a recurrence of acute attacks.

Certain sanitary measures must be included in the program along with strict observations of the milking order. Individual cloths dipped into fresh hypochlorite solution (200 to 400 parts of chlorine per million) should be used to wipe the udder, teats, and flanks of each cow before milking. Never put these cloths back into the solution after using. The cloths should be sterilized each time after they are used. After milking, the teats should be washed with the hypochlorite solution.

Proper feeding must also be considered. Cows with mastitis or exposed to the disease should not be fed high protein grain rations. Protection of the udder from injury and infection is of equal importance. Ample bedding and stall space are necessary. To keep down infection floors and stalls should be washed regularly and disinfected with 3 to 5 percent lye solution. As an additional safeguard plenty of lime or superphosphate in back of the stalls and in the gutters is important.

Reference: 1942 Yearbook of Agriculture, "Keeping Livestock Healthy," pages 518, 522.

Milk Fever

Milk fever, also called parturient paresis and parturient hypocalcemia, is an infection of cows occurring shortly after calving. It is characterized by paralysis of the motor and sensory nervous apparatus. Despite its name, milk fever usually is not accompanied by fever. There is always, however, a marked and rapid lowering of the blood calcium, so that the name "parturient hypocalcemia," which means too little calcium at calving time, is quite appropriate.

Milk fever is one of the most common, widespread, and serious of the acute afflictions of dairy cows. It affects almost exclusively the high producing, better nourished animals. It very rarely occurs at the first calving; sometimes at the second calving; and most frequently after the third to seventh calf, or during the prime of life. The poorly nourished cow is seldom a victim, and difficult calving (dystocia) is hardly ever followed by milk fever. After the first attack, the trouble may recur at one or more subsequent calvings.

Cause. Most veterinary writers begin their discussion on the cause of milk fever with work done late in the nineteenth century and the early part of the present century. In 1879 Schmidt, the Danish veterinarian, acting on the theory that milk fever resulted from an infection of the udder, experimented with injections of a solution of potassium iodide into the udder of sick cows. This treatment proved satisfactory but did not explain the theory of infection. It was later found that injections of air along with the potassium iodide solution gave equally good results. Later it was found that injections of oxygen or filtered air alone proved superior to the injection of potassium iodide alone or potassium iodide and air mixed. This treatment proved so satisfactory that it was accepted and research workers failed to continue trying to discover the direct causes of the disease.

In 1925, Dryerre and Greig proposed a theory that milk fever is an expression of acute deficiency of calcium in the blood. Examination of blood of affected cows showed a marked deficiency of calcium. When calcium gluconate solution was injected intravenously in an appropriate dose to affected cows a cure was promptly effected. The question may be asked then how does inflation of the udder with potassium oxygen or filtered air have a curative effect. Greig explains this by stating that forcing the air or potassium iodide solution into the udder prevents the further interchange of calcium from the blood to the gland acini. There is also reason to believe that the calcium which is heavily concentrated in the gland is forced back into the blood as the result of the mammary distention.

Chemical studies have revealed other abnormalties in the blood of cattle suffering from milk fever. In some cases an increase in the blood magnesium, in others a decrease of blood magnesium, and also a decrease in phosphorus and an increase in blood sugar have been observed.

Symptoms. The first symptoms, depression and disinclination to move about or to eat, may set in as early as 6 hours after calving, but more often they begin anytime from about the twelfth hour to the third or fourth day. Although milk fever symptoms may at times appear before parturition or even several weeks afterwards, such cases may be involved with other affections common to the parturient or post-parturient state, and the diagnosis should be confirmed by laboratory aid. Cases have been observed in which the animal appeared excited and highly nervous for a short time, with twitching of the muscles and by jerking of the legs and head, but the classical picture of milk fever begins, as already stated, with depression, and this followed by collapse and complete loss of consciousness. The animal lies with its head turned to one side, the eyes are dull and expressionless, the membrane covering the eye is reddened, the muzzle is dry, the extremities are cold, and the body temperature is usually below normal.

Udall states that one of the most constant and characteristic signs in milk fever is a tonic spasm of the muscles of the neck, giving the neck a distinct lateral kink. This symptom is seen more frequently than the turning of the side. Throughout an attack the animal ceases to feed or ruminate, and all body functions are at a low ebb. The pulse and breathing are accelerated, the breathing often being labored and accompanied by groaning. Bloating is not uncommon. The most frequent complications of milk fever are pneumonia, which generally occurs as a result of inhaling food material regurgitated from the paunch while the animal is lying down, and septic inflammation of the womb from various causes. Animals that are not appropriately treated usually die within several hours to a few days.

Prevention and treatment. Among the serious cattle plagues, milk fever is unique in that its treatment when properly carried out is remarkably successful, while practical and effective preventative measures are lacking. Of the suggested means of prevention, the injection of a solution of a calcium salt directly after calving is worthy of mention, as is also the practice of partial instead of complete milking during the first several days after calving. Obviously, however, the former procedure is more or less experimental and not practical, and the latter may lead to mastitis. Special measures should be taken to insure an adequate ration for, and proper care of, the pregnant and parturient cow.

As already mentioned, however, there are two methods of treatment that are efficaious if properly carried out, but to insure success, treatment must be instituted as early as possible. The procedure preferred by veterinarians consists in intravenously injecting calcium gluconate in 20 percent solution. It is sometimes necessary to repeat the injection one or more times to effect a cure. Solutions of other calcium salts may also be used, but care must be taken that the solution does not enter the tissues surrounding the vein, since this causes severe irritation, often leading to swellings or sloughing. The injection should not be made under the skin.

The alternate procedure, consisting of inflation of the udder with filtered air, must be undertaken with great care so as to avoid introducing infection by contaminating the teat canal. Equipment must be kept sterile and ready for use at all times. Before beginning the actual inflation, a clean sterile cloth is placed under the udder, the udder and teats are cleansed with warm soapy water and dried with a sterile towel, and the teats and their orifices are disinfected. Each quarter is fully distended with air, and the teat is tied with a flat tape or bandage which is removed after no more than 3 or 4 hours. During an attack the animal should not be permitted to lie on its side, since there is danger of pneumonia from inhaling regurgitated paunch contents; bracing the animal so that it rests on its brisket will prevent this.

Usually with either the calcium-glucose or dextrose injection or the air-inflation treatment the response is rapid. In complicated cases the animal returns to consciousness in less than an hour and is often on its feet in 2 to 4 hours after treatment. The body temperature and digestive and eliminatory functions return to normal, as evidenced by the resumption of rumination, defecation and urination. In certain cases both procedures may be used, the one assisting the other in bringing about recovery. When medication in addition to the calcium salts is deemed necessary, the veterinarian always administers it by the vein, or hypodermically, and not by a drench, since there is danger that the medicine might pass down the windpipe and cause pneumonia. When treatments fail it is usually because there are complications, such as septic inflammation of the womb, pneumonia, or some serious involvement of the digestive organs.

Reference: 1942 Yearbook of Agriculture, "Keeping Livestock Healthy." pages 533-536.

Shipping Fever or Hemorrhagic Septicemia

Shipping fever, or stockyard fever, is an infectious disease of cattle usually attended with a high mortality. Its medical name, "hemorrhagic septicemia," was given it because it is a septicemia, or poisoning, of the blood (and hence often runs a short, fatal course), and hemorrhages in the body tissues and organs of animals dead from the disease are usually an outstanding characteristic.

The disease occurs in cattle in all parts of the United States. The losses appear to be greatest among young animals, especially those that are thin and poorly nourished. A large number of outbreaks of hemorrhagic septicema in cattle are associated with the shipment of animals from one point to another by rail or truck and their passage through public stockyards. The vitality of animals is lowered by the hardships of transit, and their resistance to infection is decreased. The disease is, therefore, a serious problem to both shippers and receivers of cattle. In some years very considerable losses occur; whereas in other years they may be slight.

Cause. According to the older school of thought, the principal causative factor is the germ, **Pastuerella boviseptica.** The organism has been found in the air passages of normal animals and organisms closely resembling it are widely distributed in nature.

According to the newer school of thought, the hemorrhagic septicemia organism probably plays a secondary role, like that of diphtheroids, streptococci and bacillus coli organisms, and there is another primary infective agent concerned in the production of the disease. The nature of this agent is not known, but it is thought by some to be a virus. When cattle are received after a hard railroad journey many of them may manifest symptoms of the disease, and local stock that come in contact with the affected animals very often become infected.

Symptoms and lesions. Shipping fever in cattle usually develops very rapidly and lasts from 2 to 8 days or longer. Affected animals first show an elevation of body temperature, ranging from 104° to 107° F., accompanied by loss of appetite, mucopurulent discharge from the nose, an occasional hacking cough, swollen, watery eyes, general depression, gaunt appearance, stiffened gait, and sometimes diarrhea. Within 3 to 5 days after the first symptoms appear, affected animals may develop pneumonia and die in 48 to 72 hours; or the disease may assume a chronic course, and the sick animals may linger on for several weeks. In mild attacks, affected animals may recover in a week or two.

Other symptoms may occur, such as swelling beneath the skin of the head, throat, or dewlap. The tongue is often extensively swollen, and the animal drools and slobbers because of the irritation to its tongue and throat. There may be difficulty in breathing depending on the degree of involvement of the air passages and lungs. Muscular trembling may be evident. There may be a blood-stained discharge from the nostrils, and strings of mucus may hang from the mouth. Examination of the nostrils often reveals the presence of many small hemorrhages, or blood spots, just beneath their lining membranes.

There is an intestinal form of the disease in which the changes are found chiefly in the abdominal cavity. This form may develop after the disease has appeared in the lungs. The stomach, intestines and kidneys and the lymph gland belonging to them become studded with hemorrhages of various sizes, and the intestines become intensely inflamed. Diarrhea sets in, and shreds of mucus and bloody droppings are passed. The intestinal form is rare, most of the cases show severe involvement of the lungs and the symptoms of croupous pneumonia. The animals may stand with their forelegs wide apart in order to breathe more freely. They lose flesh very rapidly, their abdomens become "tucked up" and the eyes quickly become sunken. A staggering gait, caused by extreme weakness is sometimes noticed.

Diagnosis. It is often difficult to diagnose hemorrhagic septicemia because of its similarity to certain other disease conditions encountered in cattle. Owing to its acute course, high fever, and rapid termination, the disease may be mistaken for anthrax, malignant edema, or blackleg. While certain characteristic features of these diseases may aid in making a tentative diagnosis, a bacteriologic examination which includes both cultural tests and inoculation of laboratory animals is sometimes necessary to detect the nature of the disease and especially to differentiate it from others.

Other conditions in cattle, such as coccidiosis, cornstalk disease, lead poisoning, sweetclover poisoning, and other forms of vegetable poisoning may be mistaken for hemorrhagic septicemia. In an outbreak of suspected hemorrhagic septicemia, diagnosis, treatment, and methods of control should be left to an experienced veterinarian.

Control and prevention. In considering measures for the control and prevention of this disease, it is important to remember that hemorrhagic septicemia is the most serious of the group of cattle maladies that commonly result from mishandling, neglect, or exposure of animals in transit or shortly after their arrival at their destination. Hence the elimination of predisposing factors, such as overdriving, overcrowding, overfeeding, and lack of rest, water, feed, and proper shelter during transit is stressed.

The use of biological products to prevent hemorrhagic septicemia or to control outbreaks has been successful in many instances, but unsatisfactory results have followed in some outbreaks.

The biological products used are either preventive (bacterin and aggressin) or curative (antiserum). Bacterins or aggressins increase the animal's resistance against hemorrhagic septicemia infection. They produce an active immunity of long duration, usually several months to a year. It is believed that a high degree of immunity is established in 10 days to 2 weeks after a vaccination with either bacterin or aggressin.

For best results feeder and stocker cattle should be treated with bacterin or aggressin at least 10 days before shipment, as the use of these products on animals in transit or a few days after they reach their destination appears to be of little or no value, according to experimental work by the Bureau of Animal Industry and other agencies.

The advisability of using biological products and their administration should be left to a competent veterinarian.

Since hemorrhagic septicemia is an infectious disease, the carcass of animals that have died of it should be burned or buried. Premises are usually contaminated by infected cattle that have recently passed through some of the larger markets. All stables, sheds, or yards that have contained infected animals should be disinfected. The interior of the stables, especially the mangers and gutters, should be washed with a disinfectant, such as compound cresol solution, 4 ounces to a gallon of water, or carbolic acid, 6 ounces to a gallon of water. For dairy barns, however, where the odor of these disinfectants would be objectionable, milk of lime or some other nonodorous disinfectant may be preferred. The yard may be disinfected by the application of a solution made of 5 ounces of copper sulphate to a gallon of water. The best way to apply disinfectant solutions is with a spray pump such as is used in spraying orchard trees. All refuse and waste material from the stable and barnyard should be removed to a place not accessible to cattle or sheep. The manure should be spread on fields and plowed under. A plentiful supply of light and air should be provided for the contaminated stables. Open fields or pastures are cleansed rapidly by the action of sunlight.

Reference: 1942 Yearbook of Agriculture, "Keeping Livestock Healthy," pages 526-532.

Anthrax

Anthrax is an infectious disease of livestock caused by a specific microorganism or germ known as the anthrax bacillus (bacillus anthracis) and characterized in its most common form by a rapidly fatal course or by sudden death. The disease causes annual losses of many millions of dollars to the livestock industry. As it is also infectious to man, anthrax is a menace to public health.

Susceptibility of animals. Practically all animals are susceptible in some degree to anthrax, but the herbivorous animals are most susceptible. Cattle, horses, sheep, goats and wild herbivorous animals are most commonly affected, and in these animals the disease usually appears in the acute form which rapidly terminates in death.

Modes of infection and dissemination. It is generally considered that anthrax infection for the most part occurs by way of the digestive tract.

Contaminated drinking water is also a potent source of infection.

Infection may also occur by way of the skin through anthrax spores from the soil lodging in wounds and abrasions or through punctures made by biting insects that had previously fed on diseased animals.

Soils contaminated with anthrax remain dangerous for long periods, requiring only favorable climatic and moisture conditions to cause repeated outbreaks of the disease and the consequent reinfection of the land. Additional territory may in turn become contaminated through the wandering of diseased animals.

Dogs and other carnivores, as well as the carrion-eating animals and birds, are potential spreaders of anthrax from one area to another.

Some of the flying insects must be considered as potential spreaders of anthrax, feeding as they do on the blood of living animals or on the materials that escape from the natural openings.

Streams contaminated with surface drainage from anthrax-infected land or by carcasses of animals dead of anthrax may convey germs many miles downstream, infecting the territory through which they pass.

Symptoms. According to the course of the disease, anthrax is recognized in three forms: a peracute form, in which the interval between the first outward manifestation of symptoms and death is but a few hours or even minutes; an acute form, in which the disease lasts for a day or two; and a subacute form, in which the period between first symptoms and death or recovery extends beyond several days.

In the peracute form of the disease, death occurs so quickly that clinical symptoms are seldom observed. In the great majority of instances animals that when last seen were apparently in perfect health are found dead. Less often a seemingly healthy animal is seen to fall to the ground, go through a few convulsive movements, and die. Closer examination frequently shows blood-stained discharges from the nose, mouth, and anus. Peracute anthrax occurs most often in the beginning of an outbreak among cattle and is the most common form of the disease in sheep. Sudden death in cattle, sheep and horses in areas where anthrax previously existed should always be viewed with suspicion, and the owner should be on the lookout for anthrax.

In cattle, in addition to the peracute form of the disease in which few symptoms are seen, acute and subacute infections develop. In these forms there is first a stage of excitement, which is soon followed by depression. In this stage the animal lags behind, with the head hanging low, refuses to eat and prefers to stand still or to lie down. Respiration is more rapid than normal and appears to be labored. Rumination ceases, and in milking cows the milk secretion is materially lessened. Pregnant animals may abort. At this stage of the disease the body temperature is elevated and may reach 108° F. Bloody discharges usually come from the natural body openings. When diarrhea sets in, the feces are usually blood-tinged. Small hemorrhages may be noted on the visible mucous membranes. Soft swellings that pit on pressure may develop over the body, but the more common sites are about the external genitalia and on the lower wall of the abdomen. The tongue also may show extensive swelling and dark discoloration.

Shortly before death respiration becomes extremely labored, the mucous membranes take on a bluish cast, and the temperature falls below normal.

Anatomical changes. If anthrax is suspected, the stockman should consult a veterinarian at once rather than open up a carcass for the purpose of making a definite diagnosis. The seriousness of such a mistake can hardly be overestimated, owing to the greatly increased danger of spreading the disease when the body is opened and discharges from it escape. Post-mortem examination in suspected cases of anthrax should be made by a qualified veterinarian who is prepared to take all necessary precautions against infecting himself and the premises.

Carcasses of animals dead of anthrax decompose rapidly and soon become greatly bloated. The natural post-mortem stiffening of the muscles is incomplete. Dark blood escapes as a rule from the natural openings, and the visible mucous membranes are dark blue in color and frequently show hemorrhages. The blood is considerably darker than normal, does not clot readily, and is frequently spoken of as being tarry. Hemorrhages beneath the skin are common. Clear or somewhat blood-tinged gelatinous exudates are found between the muscles and beneath the skin, especially in the areas where the swellings were seen before death.

Control measures. Anthrax is a menace to the livestock industry and requires the concerted defensive action of livestock sanitary officials, local veterinarians, and owners. When the disease threatens or invades one's herd, it is advisable to obtain the assistance of a qualified veterinarian or State official, who is in a position to advise intelligently on the most effective means of control.

The first line of defense against anthrax consists of the prompt and proper disposal of animals dead of the disease.

The second line of defense is vaccination for prevention or cure in accordance with methods recommended by livestock sanitary officials and other experienced veterinarians.

The third line of defense consists in fencing, wherever practicable, to exclude livestock from pools, swamp land, and pasture where anthrax infection is known to exist.

Disposal of carcasses and disinfection. In the control of anthrax prompt and effective disposal of carcasses is of greatest importance. It is good practice to dispose of all animal carcasses properly, especially in an anthrax area, even though the possibility of anthrax may at the time seem remote. This can be accomplished either by complete cremation or deep burial under a layer of quicklime covered with at least 5 feet of earth. Carcasses should not be buried in low swampy land or adjacent to streams where overflow might inundate the grave or on a hillside where there is a possibility of subsurface drainage reaching the surface at lower places nearby. The area above and around the grave should be saturated with oil and burned over. The method to be employed will be governed by the prevailing weather conditions and the relative promptness and ease with which each procedure can be carried out at the place where disposal becomes an issue.

In disposing of a dead animal the following method is recommended: Immediately after finding the animal, cover it with kerosene or crude oil to keep flies, dogs, buzzards, crows, and vermin from the carcass until it is disposed of. If conditions permit, cremate or bury the carcass where it is found. If moving to a more suitable site is necessary, take the greatest care to prevent any discharges or hair from contaminating the soil over which the carcass is moved. Consequently, never permit a carcass to be dragged. A stone boat or sled may be used as a means of conveyance. Thoroughly disinfect or burn any equipment used in moving anthrax-infected carcasses. Avoid actual contact with the germ-laden body; this can be done through the use of properly applied ropes and poles, which may then be burned. Prepare a solution of bichloride of mercury to disinfect the hands and boots or shoes of the operator after the disposal of the carcass has been completed.

Preventative vaccination. Where anthrax appears more or less regularly each year, vaccination affords the best means of holding the losses to a minimum.

Proper immunization against anthrax is a highly technical problem that involves the understanding of the principles of immunity as well as expert knowledge of available immunizing agents, the nature of each product, the immunizing value of each, and its limitations. Anthrax vaccination is, therefore, a procedure that should be under the immediate supervision of a qualified veterinarian.

Treatment. When the progress of the disease is not too rapid, treatment with large doses of anti-anthrax serum administered by a qualified veterinarian is frequently successful. When used either as a preventative or as a curative there is no danger of giving an overdose of the serum, but there is a possibility of giving quantities which are insufficient to accomplish their purpose. No other known product, drug, or combination of drugs can be depended on to cure an established case of anthrax in animals.

Reference: United States Department of Agriculture Farmer's Bulletin 1737, "Anthrax", October 1934.

Bang's Disease (Infectious Abortion)

Bang's disease, infectious abortion, contagious abortion, and abortion disease are different names for a livestock disease, especially prevalent in cattle, that causes heavy losses in the United States and most other countries. It has existed for centuries although for a long time its cause remained obscure. During recent years it has gained additional prominence and has become a matter of growing concern to those engaged in raising and handling cattle. As interest in the production of better stock has increased and as the long-distance shipment of animals has become more common, conditions have not only become more favorable for the spread of the disease but have made the losses which it causes of greater consequence to cattle owners.

Nature of the disease. Although the act of abortion is the most readily observed symptom of the disease it has been noted also that in affected herds (1) sterility, or barrenness, is commonly more or less troublesome; (2) animals give birth to calves which, although living, may be too weak to resist some of the more common ailments; (3) cows show a tendency to retain their afterbirths, and (4) a reduced milk production is occasioned by the failure of animals to complete their normal gestation periods. Losses due to these conditions may equal or even exceed those represented by the number of calves that are born dead.

Location of brucella abortus in infected animals. The act of abortion furnishes little information as to when the disease was contracted or when it will be overcome by an animal. The tendency on the part of the germs to multiply in the bodies of animals for long periods justifies the recognition of the disease as a chronic malady.

The fetus, fetal membranes (afterbirth), and discharges from the generative organs at the time of aborting and for a variable period afterwards are usually saturated with the germs. Discharges shortly before the act may also contain the infection.

The aborting animal, moreover, is not alone responsible for scattering the infection. Infected cows, although they produce seemingly normal calves, may be as menacing to healthy stock as if they had aborted, because their afterbirths and uterine discharges may contain myriads of the abortion germs, a feature that until recent years escaped observation.

Only in rare instances have the germs been found in the genital tracts of cows for any great length of time after the dead or living calf has been expelled. Experimental tests indicate that they are seldom present in the discharges longer than 3 or 4 weeks, although in rare instances they have been found nearly 2 months after the expulsion of the calf or fetus.

The udders of many infected cows, whether they abort or not, contain and eliminate the germs for a widely variable period. Investigators have never been able to understand or account for the wide variation that exists in the length of time that udder infection persists in different animals.

Symptoms. The symptoms or signs that denote the presence of Bang's disease are rather inconstant and indefinite. The act of abortion is probably the most widely known and most readily observed, but it may easily be misinterpreted, since not all cows that abort are affected with the disease. Its prompt recognition in diseased herds, is moreover, rendered difficult because of the fact that many animals that acquire the disease never abort.

When the act of abortion occurs it may be preceded by changes commonly observed in cows approaching normal parturition, such as enlargement of the udder, slight swelling of the external genitals, uneasiness, and straining. Discharging from the genital tract preceding the act may occasionally be observed. The fetus may be expelled during any stage of its development. If the fetus is small, the act of abortion may occur unobserved.

When the dam aborts during the early months of pregnancy, the afterbirth, not being firmly attached to the uterus, is usually expelled with the fetus, whereas during the latter months of gestation its retention is common. Some fetuses may be born alive but to weak to survive more than a day or two.

Fluid or semi-fluid materials are eliminated from the genital tracts of aborting animals for a variable period following the act. The length of time that such discharges continue to be expelled depends on both the severity of the disease in the uterus and the manner of treatment employed. The discharges are usually brownish or yellowish brown, but may not differ greatly in appearance from discharges in cases of retained afterbirth, not caused by the abortive germ. The afterbirth, when expelled or removed and examined before becoming markedly putrefactive, frequently shows changes that aid the trained observer in recognizing abortion disease.

Areas of the membrane that are normally thin and translucent may present a leathery appearance or be studded with small elevations, and the borders of the cotyledons (tumor-like enlargements where union between dam and fetus is established), may consist of a cheese-like substance. The irregular surface of some of the cotyledons may likewise be occupied by this cheese-like material. The absence of these changes, however, does not necessarily indicate that the abortive germ has not been active.

Diagnosis. Cattle owners have shown unusual interest in the diagnosis of

Bang's disease, since it plays such an important part in eradication programs. There has been some skepticism about the reliability of the agglutination test, the one commonly used. Before the discovery that the infection may establish itself in the udders of cows and be eliminated in the milk for long periods of time, there were reasons for doubting the accuracy of the test. The fact that many reacting animals have produced living vigorous calves has sometimes been erroneously regarded as indicating that the test is unreliable. It is now well known that the results of the agglutination test throw very little light on whether or not the tested animals will abort, but they do give a reasonably accurate idea as to whether the animals harbor the abortion germs in their bodies. It is true that many animals recover from Bang's disease and cease to be carriers of the abortion germs after once having contracted the disease, and also that the test fails to differentiate sharply between present and past infections. However, it is possible to distinguish with considerable accuracy between present and past infection by the intensity of reaction.

Treatment. Treatment in many cases should be given the aborting animal, particularly when there is retention of the afterbirth. Vaginal and uterine douches with nonirritant, antiseptic fluids or solutions of common salt, when properly made, seem to hasten recovery of the generative organs and frequently prevent subsequent barrenness. Treatment of this character, however, should be undertaken with the idea of washing the germs out of the generative organs and relieving inflammation, and not with the expectation that abortion germs will thereby be completely destroyed.

Control and eradication. Although the disease may be excluded from non-infected herds with reasonable care, it is much more difficult to eradicate it from infected herds. It is especially discouraging when the disease is running rampant and abortions are occurring frequently. Under these conditions animals may abort unexpectedly in many cases and scatter infectious material over wide areas before being discovered and separated from the rest of the herd. Success in dealing with the problem under these conditions is likely to involve considerable expense. On the other hand, if the disease is more quiescent, and comparatively few abortions occur, the problem of eradication may be greatly simplified.

It is doubtful whether or not any one method of dealing with infected herds is well adapted to the needs of every herd owner, and will deal satisfactorily with all degrees of infection.

Test-and-slaughter method. The test-and-slaughter method is similar to the one used so effectively in the eradication of tuberculosis. The method involves the immediate disposal for slaughter of the animals which react to the test, and thorough disinfection of the stables. In following this plan it is necessary that repeated tests of the herd be made at intervals of from 30 to 60 days, and that the same disposition be made of any subsequent reactors before they have had an opportunity to abort and spread the infection.

Test-and-segregation method. Another method of dealing with infected herds is to subject the entire herd to the agglutination test and segregate all animals into two units occupying different premises. One unit is made up of reactors and the other of non-reactors to the test. This method often appeals to owners who find it impractical to dispose of reactors for slaughter. It can sometimes be practiced at no great additional expense to the owners, and enables them to eradicate the disease more gradually and in such a manner as not to affect profits seriously. The test-and-segregation method is especially appropriate in larger herds which have access to two or more buildings. Although the herd is separated in accordance with the results of the original test, it is necessary that the non-reacting unit be tested at intervals of from 30 to 60 days in order that subsequent reactors may be detected and promptly removed before they constitute sources of infection. A number of tests may be required to detect all the animals that harbor the germ or that acquire the disease.

Sanitary management. Sanitary management is not very popular since it is a more or less continuous undertaking requiring both vigilance and perseverance. Although it fails to insure freedom from abortion losses it frequently accomplishes highly beneficial results.

Make frequent observations of all animals for sypmtoms of aborting, such as swelling of the external genitals or udder enlargement; and when such an animal is discovered place her immediately in a separate stall well away from other stock. If an abortion occurs unexpectedly, isolate the animal in the same manner as soon as the discovery is made. Bury or completely destroy the fetus and afterbirth if the latter has been expelled. Clean and apply disinfectant solutions to areas that may have been contaminated by the abortion products.

Place all pregnant animals in individual stalls a week or 10 days before calving and confine them to their calving quarters for a month following calving and as long afterwards as uterine discharges can be detected.

Clean and disinfect the maternity stalls before placing pregnant animals in them; otherwise they may constitute sources of infection. Avoid carrying germ laden material from maternity stalls to other parts of premises on hands or clothing. The footwear of the attendant should be well scrubbed with a disinfectant solution after he has been in an infected stall.

Refrain from breeding cows for at least 2 months after calving or aborting. Bulls serving cows after such an interval should rarely if ever acquire the disease thereby or contaminate their generative organs with the causative germs.

Keep aborting animals isolated for a period of from 6 weeks to 2 months. Cows with uterine discharges should always be kept away from the rest of the herd, whether they have aborted or not, until they have recovered.

Dispose of the bedding used by infected or suspected animals in such manner as to render it inaccessible to stock that are free from the disease.

Use care in the management of the bull. Do not permit him to run with the herd or serve cows on lots that are occupied by stock free from Bang's disease.

Vaccination. Vaccines, bacterins, and serums have been used. Abortion vaccine contains living abortion germs; abortion bacterin, the germs which have been killed; and abortion serum, the fluid portion of the blood of animals that give a marked reaction to the abortion tests. The customary practice is to inject one of these substances beneath the skin of the animal that is to be rendered immune.

Numerous investigators who have studied the value of these substances have arrived at the conclusion that the benefit derived from the use of bacterin and serum is not sufficient to compensate for the labor and expenses involved in their administration. Abortion vaccine, on the other hand, has yielded encouraging results and may have considerable practical value in combating the malady.

Reference: United States Department of Agriculture Farmer's Bulletin 1704, "Bang's Disease (Infectious Abortion)."

Infectious Keratitis, or Pinkeye

Inflammatory conditions of the eyes of cattle are referred to medically as ophthalmia, conjunctivitis, and keratitis, the term used depending somewhat on the parts of the eye involved or the extent of the inflammation. The common name for all of these is pinkeye.

The disease is quite widespread throughout the country. As with other diseases of an enzootic nature (that is, prevalent in various districts), it is difficult to explain why it becomes more widespread and virulent during certain years and in certain localities. Whether seasonal and environmental conditions may influence such outbreaks is not definitely known. Although it is apparently not confined to any particular season, the disease is rarely observed during the winter months. It affects old and young animals alike.

There are practically no fatalities from the disease, but it has an economic aspect because it results in poor condition, loss of body weight, reduction in milk secretion, and general lowering of production when a large number of animals are affected.

There is usually some general disturbance, as evidenced by a rise of temperature, partial loss of appetite, suspended rumination, decrease in the milk secretion, and indications of increasing debility in advanced cases.

Treatment. In view of the probably infectious nature of the disease, when the eye infection appears in the herd, all unaffected cattle should be moved promptly to other barns or pastures if this is feasible. The diseased cattle should be housed in dark stables or sheds and provided with plenty of fresh drinking water and soft, succulent feed. Depending on the size of the animal, administer 1 to 1½ pounds of Epsom salts dissolved in water.

Cocaine may be applied to the eyes when there is evidence of pain. A 1 percent solution of silver nitrate has given good results as an eye lotion. This is applied every other day until there are definite indications of improvement, then every third or fourth day until the inflammation subsides. The silver nitrate solution should be fresh when used, and may be applied to the eyes with a soft cotton swab, care being taken not to cause further irritation by undue rubbing or pressure. Less satisfactory results are obtained from applications of boracic acid solution. A more recent treatment recommended for keratitis is mercurochrome. Bardens reported having obtained very satisfactory results with mercurochrome in 1 to 4 percent solutions dropped in the eyes several times daily. The stronger solution is recommended in case of ulceration of the cornea. It is claimed to be less irritating to the eyes than the silver preparations.

Bardens also gives considerable credit to the mixed bacterins for keratitis, used simultaneously with the local mercurochrome treatment. The initial dose of the bacterin was 10 cubic centimeters, increased by 5 to 10 cubic centimeters daily until a maximum of 20 was reached. He found that two doses of bacterins were usually sufficient to correct the condition in dairy cattle.

It appears to be the concensus of opinion among veterinarians that more satisfactory results are obtained in the treatment of the disease when the mixed keratitis bacterins are used in conjunction with local treatments with the mercurochrome or silver nitrate solutions.

The treatments suggested, particularly the bacterin treatments, should be administered by a veterinarian, and, as in other infectious or contagious diseases, when an outbreak of pinkeye occurs in a herd, the owner should promptly consult his local veterinarian and follow his instructions with regard to the best procedure for the eradication of the disease from the herd.

Reference: 1942 Yearbook of Agriculture, "Keeping Livestock Healthy," pages 555-559.

Parasites

Cattle Lice

Parasites, especially lice, cause considerable damage to livestock in Misssissippi. Lice are so common that they are often neglected until the damage caused is very severe. It is important that lice be controlled in producing cattle; therefore, the symptoms and control measures for this parasite are presented in this publication.

Cattle lice are widely distributed and have been recognized as a pest by livestock growers for a considerable period of time. Cattle lice are injurious to all classes of cattle, occurring most frequently on young stock and on undernourished older cattle. Losses are caused by irritation, digestive disturbance, stunted growth, low vitality, and increased death rate.

Ordinarily lice on cattle are not observed until they have become so numerous that they cause unmistakable signs of annoyance. Usually the animals whose lousy condition first attracts attention are the poor, sick, unthrifty members of the herd, and frequently the owner thinks they are lousy because they are unthrifty, whereas the unthrifty condition may be caused by the lice.

Three kinds or species of lice are commonly found on cattle in the United States. Two of these are blood sucking or suctorial lice and are commonly known as blue lice. The third species is biting louse, commonly known as "little red louse."

Suctorial Lice

There are two species of suctorial lice. They are the short-nosed and long-nosed cattle lice. The short-nosed cattle lice are usually found on mature cattle while the long-nosed cattle lice are usually found on calves and young stock.

Biting Lice

Biting lice are found on both young and mature cattle and are much smaller than the sucking lice.

Nature and habits. Lice increase very rapidly in number on cattle during dry, cold weather when the hair is long, but when green feeds come in the spring and the animals shed the old coat of hair the lice become less numerous. Some of the lice, however, usually remain on the animals throughout the summer, but not in sufficient numbers to do harm. Treatment, therefore, should be applied in the fall while the weather is suitable and before the lice have become numerous enough to cause injury. On animals that are not treated in the fall, treatment should be applied as quickly as the weather will permit in the spring.

Method of treatment. There are three commonly used methods of applying treatment for lice: (1) hand application, (2) spraying, and (3) dipping. The best method to adopt depends on the season of the year, the remedy selected, the number of cattle to be treated, and the facilities available. In Mississipi, by selecting warm periods in which to apply treatments, anyone of the three methods mentioned can be used without injury to the cattle.

Hand applications. Hand applications may be used successfully in treating small numbers of cattle for lice. Hand application of (1) dusting powders; derris dust has been used successfully in controlling lice; (2) greases and liquids; the following remedies have proved effective when applied by hand and the treatment repeated if necessary in about 16 days, (a) cottonseed oil and kerosene, equal parts, (b) kerosene and lard mixed in the proportion of ½ pint kerosene to 1 pound lard, (c) crude petroleum, and (d) any of the dips recommended for use in dipping; (3) spraying; where an orchard spraying outfit is available, it may be used in treating animals for lice. Any of the dips recommended may be applied in the form of a spray. Two treatments given 15 to 16 days apart. When the arsenical dip is used, care should be taken to see that neither the cattle nor the operator breathes the spray. The operator should also be careful not to get clothing wet with the dip.

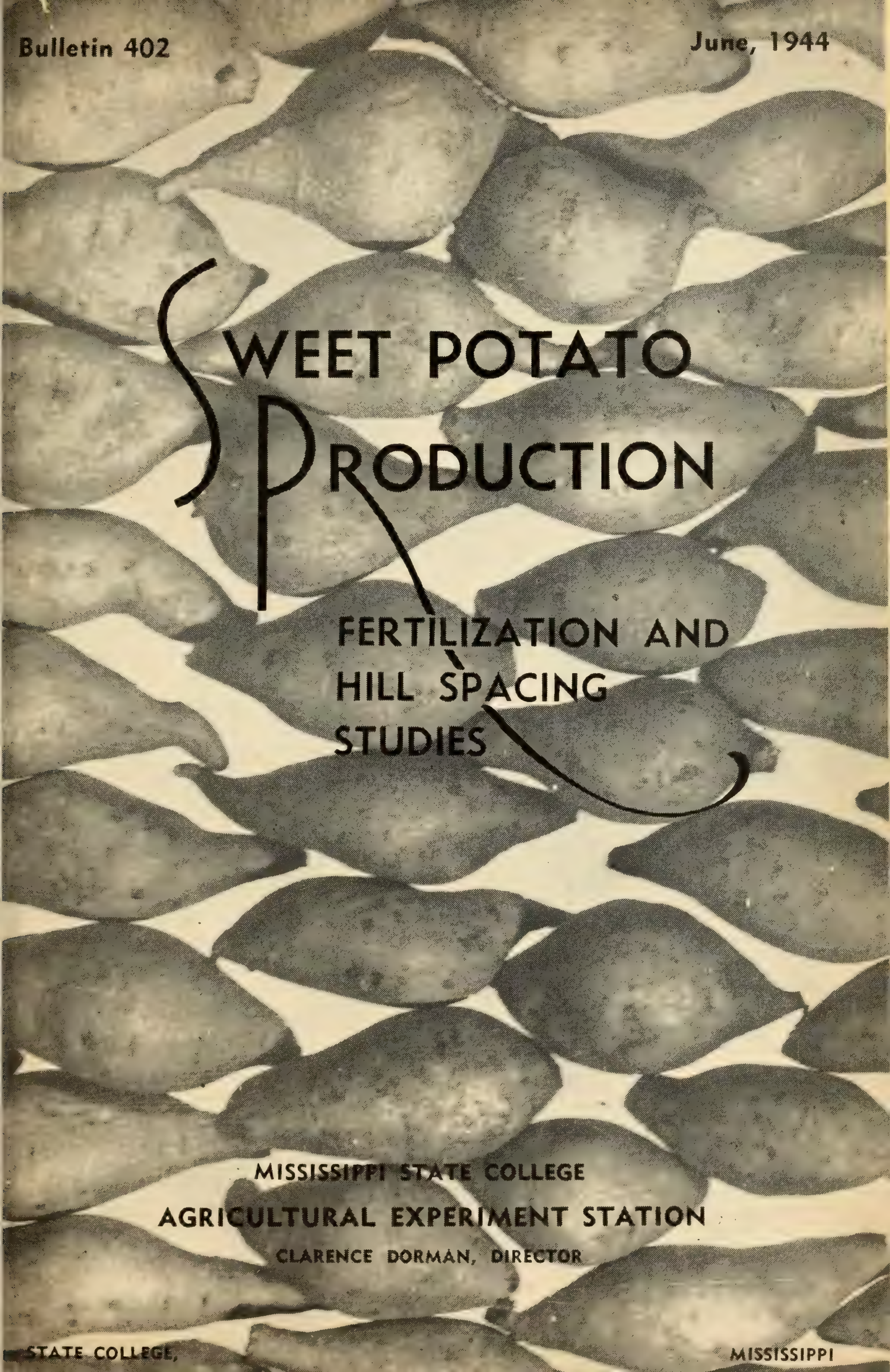
Dipping. Dipping is the most satisfactory method of treating cattle for lice. All of the cattle in the herd should be dipped twice at 15- to 16-day intervals. The following mixtures have been used successfully in treating cattle for lice.

Arsenical dip. 4 pounds caustic soda (85 percent pure)
8 pounds white arsenic (99 percent pure) in fine powder
8 pounds sal soda crystals
1 gallon pine tar
Water sufficient to make 500 gallons.

Coal tar creosote dips. The coal tar creosote dips are sold under many trade names. They are made from coal tar derivatives and the principal ingredient is creosote oil which is made soluable in water by means of soap. The coal tar creosote dip should be used in accordance with instructions printed on the label of the container.

Reference: United States Department of Agriculture Farmer's Bulletin 909, "Cattle Lice and How to Eradicate Them."

Bulletin 402 June, 1944



SWEET POTATO PRODUCTION

FERTILIZATION AND HILL SPACING STUDIES

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, DIRECTOR

STATE COLLEGE, MISSISSIPPI

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Sweetpotato Production: Fertilization and Hill Spacing Studies

By W. S. ANDERSON and JOHN W. RANDOLPH[1]

Growers of sweetpotatoes for starch or for other industrial utilization are primarily interested in the amount of total yield that can be made by any production practice. They are not interested to any extent in the grade produced; although certain sizes and shapes may be preferred by the factory, potatoes of all sizes and grades are accepted without price discrimination. The larger size sweetpotatoes are more easily handled during the operation of harvesting, thus requiring less labor per ton in harvesting than the small sizes. This relationship is illustrated by figure 1. Growers are interested also in the return they can expect for their labor and for the use of their land and equipment. Production practices which make the highest total yields do not always give the grower the highest net return. During the war emergency while there is such a limited labor supply and many materials are rigidly rationed, it becomes more important for growers to consider crop production practices which give them the greatest possible net return for each hour of their labor.

During the past 4 years, the Mississippi Agricultural Experiment Station in cooperation with the Division of Agricultural Engineering of the Bureau of Plant Industry, Soils, and Agricultural Engineering, U. S. Department of Agriculture, Agricultural Research Administration, has conducted extensive experiments in various production practices for growing sweetpotatoes for starch in the Laurel, Mississippi area. The results of those studies having to do with planting times and hill spacings have been published in Mississippi Farm Research for April 1943, and as Bulletin 378 of this Station. The results of studies of the use of mechanical equipment in sweetpotato production have been published in Bulletin 392 of this Station. This report concerns experiments with different rates of fertilizer application in combination with different hill spacings of plants and with different placements of fertilizer in relation to the position of the plants in the row. The effects of the treatments on total yields, on yields of the larger size and smaller size roots are shown, and the profits to growers are estimated in returns per man hour and per acre for each treatment.

Experiments Described

The Triumph variety was planted in these experiments because it is the variety now used for commercial starch production. In the rates and hill spacing work, the fertilizer used was a 6-8-8 mixture, 500 and 1000 pounds to the acre being applied to the plots having 10-, 20-, 30-, and 40-inch hill spacings of plants (except that in 1939 not all of these treatments were included in all experimental plantings). The experimental plots were located on various farms in Jones County and for that reason occurred on several soil types during the 4 years. All of the soils planted, however, were representative of the area in which sweetpotatoes are grown for starch. Some of the fields were moderately fertile, while others were low in fertility.

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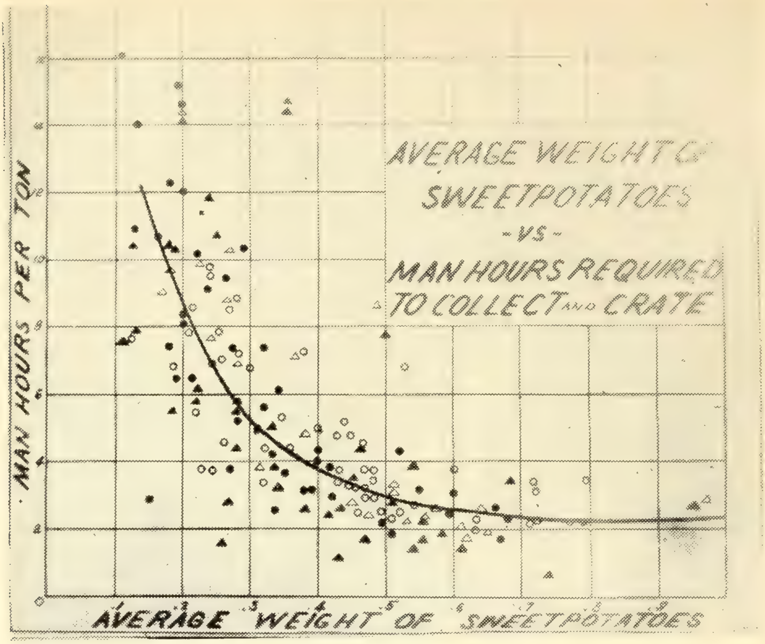

Figure 1. Man hours of labor required to collect and crate a ton of sweetpotatoes of varying average weight per root. Note that the small potatoes require more time to collect and crate.

Both ridge and terrace soils were used. In some instances the plots followed a spring harvested crop of turnips, spinach, or oats, but the most of them were planted on old land, following a crop of cotton or corn and summer legumes, usually velvet beans or soybeans. The plantings were usually made between the first and middle of May; but in 1941 and 1942 plantings were also made during the first 2 weeks of June and during the first 2 weeks of July. In 1939 they were planted on three farms; in 1940 they were planted on four; and in 1942, on one farm.

In these experiments, the transplanting and fertilizer applications were done simultaneously by employing a standard transplanting machine having a fertilizer-applying attachment (figure 2). By certain modifications of this machine, it was possible to make adjustments so as to quickly vary the rate or placement of the fertilizer application and the plant spacing. Except in 1939, this machine was operated by pulling it with a one-row tractor. In part of the placement experiments this machine was used to apply the fertilizer, and at the same time, place the plants 30 inches apart in the row.

During 1941 and 1942 tests were made of other placements of 800 pounds to the acre of factory-mixed 6-8-8 fertilizer, using the standard fertilizer and cultivator attachments on a one-row general purpose tractor. In these experiments the fertilizer was applied as the land was being ridged, and the plants were set 20 inches apart on the same day by the use of a standard transplanting machine.

Each experimental plot consisted of 3 rows 58 feet long and 42 inches apart, of which only the center 50 feet of the middle row were harvested

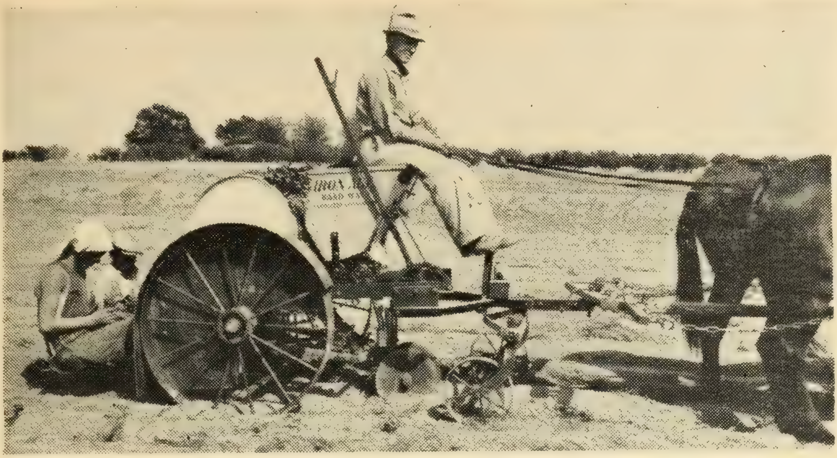

Figure 2. Equipment used in applying fertilizer and setting plants in the rates-spacing and in the fertilizer-placement experiments. Note fertilizer hopper mounted in front of water tank and the disk attachment for opening the row for side placement of the fertilizer.

for data recording for all experiments. These plots were repeated in each field from four to seven times, depending upon the suitability of the available land area in the particular field. The more or less standard farm practice methods of land preparation, cultivation, and hoeing were followed. The authors had control of these plots and directed all tillage and cultural operations in 1941 and 1942, when all work was done with a one-row tractor and the standard plow and cultivator equipment, including certain disk hiller modifications. An attempt was made in all cases to have these plots cultivated by the high or moderately high ridge method and to keep them reasonably free of weeds and grass until the vines covered the rows.

Harvesting was done in some cases by plowing up the rows with a mule-drawn rod-wing middlebuster (figure 3), but also in some cases by a tractor-drawn rod-link standard mechanical potato digger (figure 4), adapted for digging sweetpotatoes.

Because information was desired on how varying the rate and method of fertilizer application might affect the starch content of the sweetpotatoes, samples of No. 1 roots from each treatment in two blocks of all experiments were taken on the day of harvest.

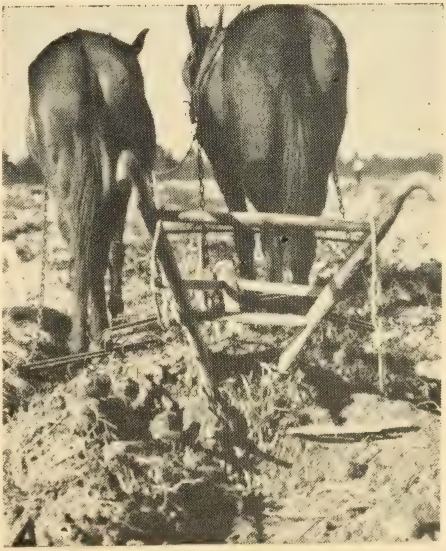

Figure 3. Rod-wing middlebuster.

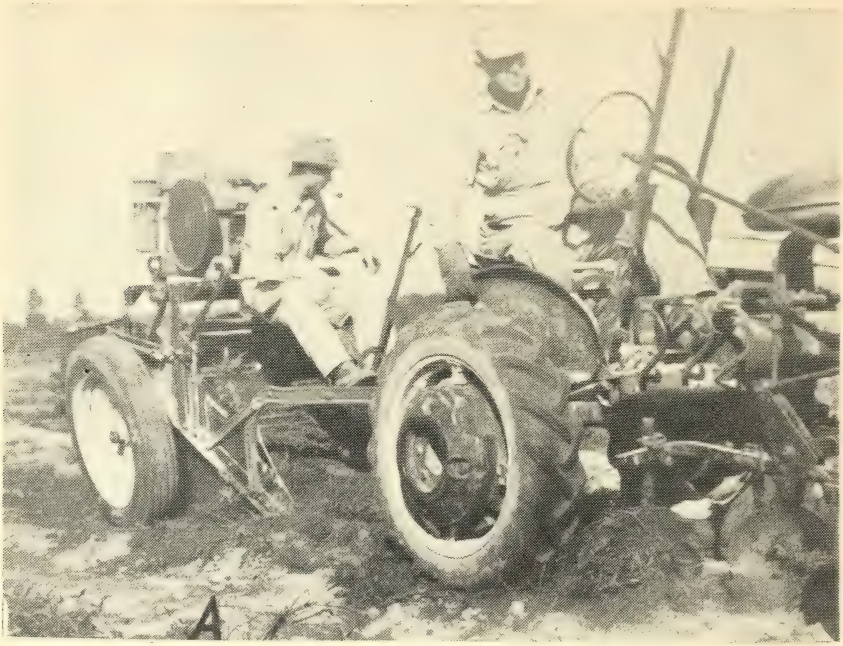

Figure 4. Mechanical rod-link-chain digger.

The percentage of moisture and of starch were determined, and that of the starch is reported herein.

The estimated profits from the practices reported herein are based upon one-row tractor equipment methods of starch sweetpotato growing. The labor for the tractor driver is charged at the rate of 40 cents an hour, while all other labor is charged at the rate of 20 cents an hour. The costs of production presented assume variable costs of harvesting different yields, as shown in Bulletin 392 of this Station (see figure 5). These harvesting charges include the procedure of collecting the sweetpotatoes in field crates which are used to loose-load a dump truck. In estimating the profits, it has also been assumed that all of the yields could be sold to a factory at harvest time at a price of 35 cents for a 60-pound bushel, the price received by growers at Laurel in 1942 for Triumph sweetpotatoes grown for starch.

Much of the cost of growing sweetpotatoes by close spacing of the plants is due to the large number of plants required and the high costs of producing and setting them. Table 1 is presented to show the number of plants required and their cost for an acre at the various hill spacings used in these experiments. Since the planting of the experiments reported herein varied from early May to early July, table 1 shows the cost of plants considered in the calculation of costs of the various treatments.

Not only do the costs of the plants themselves vary widely with the spacing of the hills, but the time required and the costs involved in transplanting them also vary. Table 2 presents data which show these varying factors. The labor requirement shown here is for average farm crews and assumes good plants, fairly easily handled for machine planting.

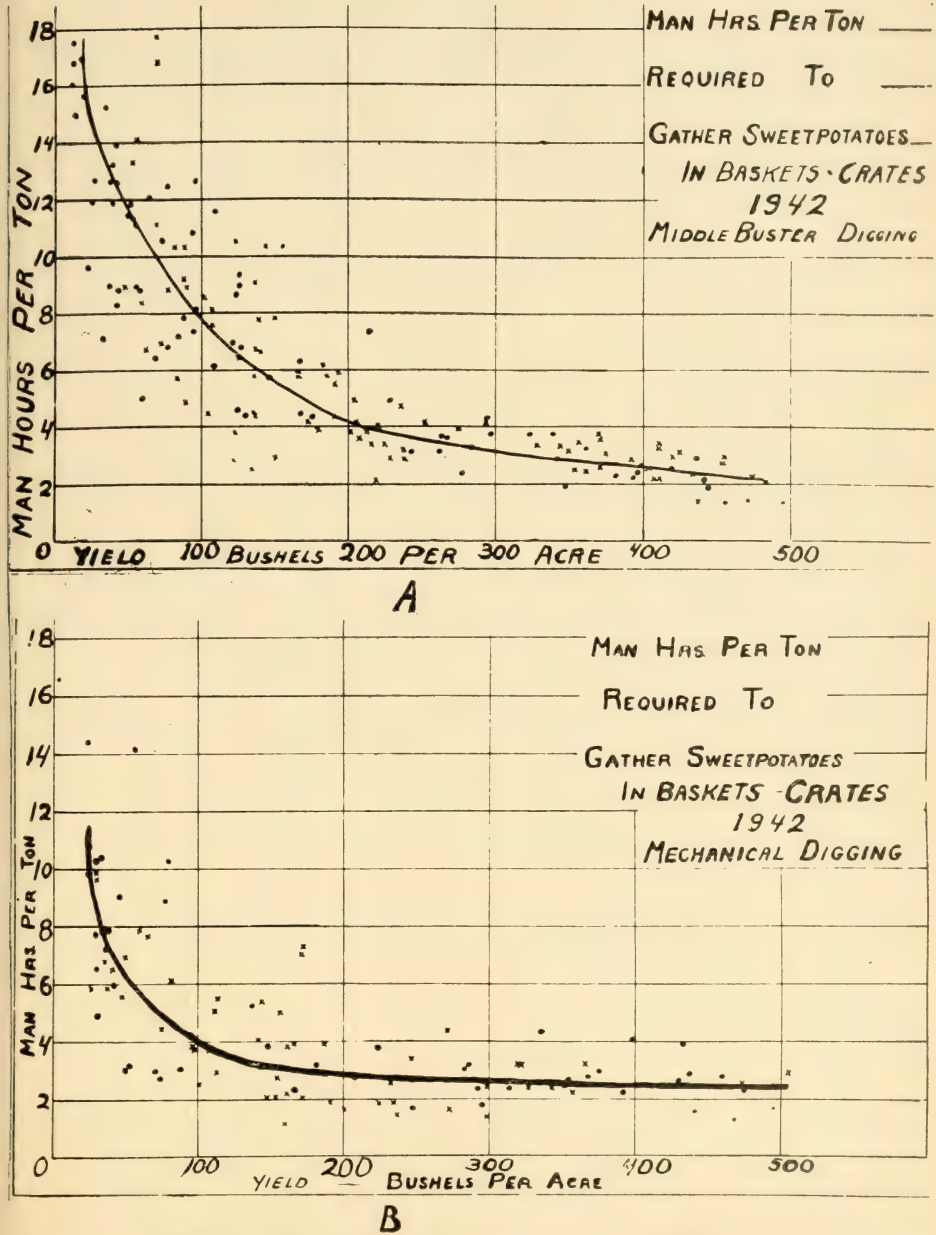

Figure 5. Time required to gather sweetpotatoes of different yields.

Table 1. Number of plants required and their costs for 1 acre of sweetpotatoes, planted at different times and hill distances.

Item	Hill spacing in inches			
	10-inch spacing	20-inch spacing	30-inch spacing	40-inch spacing
Plants to the acre	14,934	7,467	4,978	3,734
Cost of plants for:				
May 1 to 15 @ $1.53 per 1000	$22.85	$11.43	$7.62	$5.71
May 15 to June 1 @ $1.10 per 1000	16.43	8.22	5.48	4.11
June @ $1.04 per 1000	15.53	7.77	5.18	3.88
July @ $0.66 per 1000	9.86	4.93	3.29	2.47

Table 2. Time required and costs of machine transplanting 1 acre of sweetpotatoes at various hill spacings and applying different amounts of fertilizer.

Item	Hill spacing in inches			
	10-inch spacing	20-inch spacing	30-inch spacing	40-inch spacing
Man hours for:				
Transplanting	11.8	6.0	4.2	3.2
Handling water	4.5	2.3	1.5	1.1
Handling plants and 500 pounds fertilizer	2.6	2.3	2.1	1.9
Total	18.9	10.6	7.8	6.2
Tractor hours	7.5	4.1	2.7	2.2
Dollars cost:				
Labor (1 @ 40c, 2 @ 20c)	$5.30	$2.68	$2.08	$1.65
Fuel	1.28	0.70	0.46	0.37
Equipment	3.65	2.02	1.36	1.08
Water and other	0.79	0.71	0.65	0.61
Total, if applying 500 pounds fertilizer	11.02	6.11	4.55	3.71
Total, if applying 1000 pounds fertilizer	11.56	6.65	5.09	4.25

Results

Tables 3, 4, 5, and 6 show the yields of the large, the small, and the total yield of all size potatoes produced by varying the hill spacing and the fertilizer rate on various fields in each of the 4 years of 1939 to 1942, and table 7 shows the average of this period of the early and the late planted fields. These tables also show the calculated profits to the acre for each treatment in each experiment.

These results show that the yields of any fertilizer rate or plant spacing varied considerably from field to field and from year to year. They also show that there was considerable difference in yield due to different times of planting. Factors contributing to these variation were soil fertility differences, and unequal rainfall occurrence.

In 1939, the Vaughn field test was planted on a ridge soil of moderate fertility, classified as Ruston sandy loam. The data in table 3 show that in this test the highest total yield and the highest large potato yield came from the combination treatment: 500 pounds fertilizer and 10-inch spacing of plants in the row. This treatment also was decidedly the most profitable. The lowest total yield and the lowest yield of large potatoes, but not the lowest net return, came from the low fertilizer rate and wide hill spacing. The lowest profit resulted from the use of the higher fertilizer rate with close to moderately close hill spacing.

The Graves field planted in 1939 was located on a moderately fertile Cahaba fine sandy loam soil. Here, as shown by table 3, good yields were obtained from all treatments. The highest yielding treatment was the 1000-pound application of fertilizer to plants spaced 30 inches in the row. In the production of large potatoes, the 1000-pound rate of fertilizer with 30-inch hill spacing of plants also led all others, but was not much better than the 1000-pound rate with 20-inch plant spacing. The close spacings caused a greater yield of small size potatoes on the field. Because of the good yields of plots receiving low rates of fertilizer, there was no great difference between the net returns. All treatments showed unimportant differences in profit except that lower profits were secured from those receiving 1000 pounds fertilizer with 30-inch plant spacing and 1000 pounds fertilizer with 40-inch plant spacing. These two were significantly lower than the others, but not significantly different from each other.

The Hosey field planted in 1939 was on a moderately fertile terrace soil, classified as Cahaba fine sandy loam. This field had grown a spring crop of turnips which had not been cleanly harvested. On this account the condition of the soil was poor at the time of transplanting sweetpotatoes, and the stand obtained as well as the "growing off" of the plants was variable. Good yields were produced on all treatments, but the totals varied from 138 bushels from the 500-pound rate of fertilizer application and 40-inch plant spacing treatment, to 340 bushels from the 1000-pound fertilizer application with 20-inch plant spacing. The 1000-pound rate with 30-inch plant spacing and with 40-inch plant spacing were next to the lowest among the treatments and were practically equal in total yield. The treatment which made the highest total yield also made the highest yield of large potatoes and showed

Table 3. The influence of the rate of 6-8-8 fertilizer and of plant spacing upon yield and profit from Triumph sweetpotatoes grown in 1939.

Fertilizer rate, pounds to the acre	Hill spacing in inches	Bushels to the acre			Profit to the acre
		Jumbo and No. 1	No. 2 and Culls*	Total	
Vaughn field, planted May 5					
500	10	287	50	337	$40.37
500	40	105	56	161	12.11
1000	10	189	59	248	4.77
1000	20	133	48	181	1.02
1000	30	139	45	184	7.30
1000	40	173	30	203	16.10
Graves field, planted May 8					
500	10	266	96	362	47.85
500	20	238	54	292	43.22
500	40	222	52	274	45.95
1000	10	290	87	377	43.40
1000	20	283	47	330	45.65
1000	30	216	30	246	25.87
1000	40	218	43	261	33.47
Hosey field, planted May 10					
500	10	211	65	276	22.14
500	20	237	56	293	43.52
500	40	114	34	138	5.22
1000	10	249	26	275	12.85
1000	20	305	35	340	48.65
1000	30	146	13	159	—0.19
1000	40	134	21	155	17.20

*Culls as used in this bulletin refer to stringy roots that are from ¾ to 1½ inches in diameter and usable for starch.

the greatest net return per acre. Low fertilizer rates and close plant spacings on this field made the highest yields of small size potatoes.

In table 4 the data on yields and profits from the six experiments planted in 1940 are presented. Examination of these data shows that those plantings made before the middle of May yielded much more of the total grades and of large sizes than those planted later. They show also that no profit was realized from any treatment when the planting was after May 15.

In one of the Graves field tests the various treatments were in addition to an application of approximately 5 tons barnyard manure per acre, applied in a deep furrow under the row several weeks before planting. The two Graves tests were adjacent and enough alike for the results to be comparable. It can be seen that in all of the 500-pound fertilizer treatments, the manure caused a considerable increase in yield and profits. Two treatments, 500 pounds fertilizer with 10-inch plant spacing and 1000 pounds fertilizer with 10-inch plant spacing, showed fairly large losses on the un-manured test. On this field, the highest yields and the greatest profits usually were found on the lower fertilizer rates and wide or moderately wide hill spacing combinations. Thus, on the manured plots, 255 bushels yield and $40.26 profit were obtained from 500 pounds fertilizer with 40-inch plant spacing.

In the 1940 experiments, the Vaughn field test was on a moderately fertile Ruston fine sandy loam soil. Considerable differences occurred in yields and profits on this field. The total yields varied from 150 bushels from 500 pounds fertilizer and 40-inch plant spacing, to 235 bushels from 1000 pounds fertilizer and 10-inch plant spacing. The profits varied from $0.87 on the 1000-pound rate with 10-inch plant spacing, to $15.94 on the 500-pound rate with 30-inch plant spacing. On this field the closer the spacing of the hills, the higher was the total yield and the yield of small potatoes, for both fertilizer rates. It is noticeable, however, that the highest net return did not come from the highest total yields. In this field the second highest total yields usually showed the greatest net return.

The tests planted in the Walters field in 1940 were on a fertile terrace soil, classified as Amite fine sandy loam. The higher yields in this field came from the closer plant spacings on the 500-pound rate of fertilizer application and from the wider plant spacings on the 1000-pound rate. The 500-pound rate with the 10-inch plant spacing gave approximately the same yield as the 1000-pound rate with 40-inch plant spacing. The wider plant spacings with each fertilizer rate showed the highest net returns. The 1000-pound rate with 40-inch plant spacing led all treatments with a profit of $37.06, being nearly $10.00 better than the second in net return.

The plots receiving 500 pounds fertilizer with 10-, 20-, 30-, and 40-inch plant spacings gave net profits which were nearly equal. However, 10-inch spacing of plants was almost $20.00 more profitable when used with 500 pounds fertilizer than when used with 1000 pounds fertilizer. As the plant spacing was widened from 10 to 40 inches in connection with 1000 pounds fertilizer, however, the net returns increased greatly. The 40-inch spacing of plants was nearly $25.00 per acre more profitable than the 10-inch, when used in connection with a fertilizer rate of 1000 pounds per acre.

The two experiments planted on the Granberry field in 1940 were planted May 22, and because of this late planting time and the further fact that much rain caused considerable competition from grass, the yields were all

Table 4. The influence of the rate of 6-8-8 fertilizer and of plant spacing upon yield and profit from Triumph sweetpotatoes grown in 1940.

Fertilizer rate, pounds to the acre	Hill spacing in inches	Bushels to the acre			Profit to the acre
		Jumbo and No. 1	No. 2 and Culls	Total	
Graves field (manured), planted May 10					
500	10	166	75	241	$11.62
500	20	179	54	233	25.55
500	30	160	59	219	26.73
500	40	200	55	255	40.26
1000	10	167	81	248	4.76
1000	20	133	61	194	4.92
1000	30	159	68	227	20.17
1000	40	134	59	193	13.10
Graves field, planted May 10					
500	10	108	57	165	—11.14
500	20	116	65	181	9.98
500	30	104	65	169	11.75
500	40	105	52	157	10.91
1000	10	119	73	192	—12.01
1000	20	120	56	176	—0.47
1000	30	139	61	200	12.09
1000	40	129	50	179	8.91
Vaughn field, planted May 14					
500	10	125	97	222	5.93
500	20	112	72	184	10.88
500	30	120	63	183	15.94
500	40	88	62	150	8.81
1000	10	136	99	235	0.87
1000	20	137	87	224	13.90
1000	30	102	70	172	3.70
1000	40	102	65	167	13.90
Walters field, planted May 14					
500	10	215	56	271	20.60
500	20	180	40	220	21.66
500	30	161	32	193	18.94
500	40	174	28	202	24.38
1000	10	178	59	237	1.47
1000	20	157	42	199	6.42
1000	30	205	42	247	26.16
1000	40	215	58	273	37.06
Granberry field, planted May 22					
500	10	32	43	75	—34.39
500	20	68	42	110	—10.79
500	30	48	30	78	—16.07
500	40	46	33	79	—27.34
1000	10	59	39	98	—36.45
1000	20	53	44	97	—23.63
1000	30	57	34	91	—21.13
1000	40	40	28	68	—25.81
Granberry field, planted May 22, without ridging land					
500	10	45	48	93	—29.00
500	20	30	38	68	—23.37
500	30	42	33	75	—16.97
500	40	40	30	70	—16.56
1000	10	42	42	84	—40.65
1000	20	32	25	57	—35.61
1000	30	23	24	47	—34.31
1000	40	21	25	46	—32.40

too low for a profit to be realized from either of the fertilizer rates with any of the plant spacings. These data emphasize the importance of obtaining high yields in order to insure a net return.

In 1941, five experiments were planted, three in one field and one each in two others. The data in table 5 show that the early planted test out-yielded greatly the late planted. Thus, the May 9 planting in the Dennis field (Kalmia fine sandy loam soil) approximately doubled the yield of the July 12 planting in the same field. On the higher fertilizer rates, the closer spacings usually made the highest yields, but these did not give the greatest net returns. There were no losses calculated for that field in the May or June plantings except from the 500-pound rate of fertilizer with 10-inch plant spacing for the June 10 planting. At that planting time most of the other treatments made about equal net returns. At the July 12 planting only the 500-pound rate of fertilizer with 40-inch plant spacing gave a net profit of any consequence. These results agree with those reported by the authors in Bulletin 378 of this Station, and show that disadvantages usually associated with late planting cannot be compensated for by closer spacing of plants in the row.

At the May 9 planting on this field, the 500-pound rate of fertilizer application was three times as profitable when used with a 20- or 40-inch plant spacing as when used with a 10-inch plant spacing. However, the 10-inch plant spacing was approximately as profitable with 1000 pounds of fertilizer as these wider spacings were when used with the 500-pound rate. When 1000 pounds of fertilizer were applied, the profits increased by a few dollars with each widening of the spacing of plants in the row. Thus the 20-inch spacing was about $9.00 better than the 10-inch; the 30-inch $6.00 better than the 20-inch; and the 40-inch $1.00 better than the 30-inch.

The Joplin field planted in 1941 was on a moderately fertile Ruston fine sandy loam soil well supplied with organic matter. It had grown a spring crop of turnips for canning, but this crop was cut promptly as ready for harvest, and thus did not materially deplete the soil moisture supply. The total yields as shown in table 5 were good on this field, ranging from 172 bushels total on the 500-pound rate of fertilizer with 40-inch plant spacing to 326 bushels on the 1000-pound rate with 10-inch plant spacing. By a considerable margin the highest net profit, $51.01, came from 20-inch plant spacing with 500 pounds fertilizer. The lowest net return, $15.40, came from 500 pounds fertilizer with 40-inch plant spacing. In this field the total yields were much lower, for each fertilizer rate, when the plant spacings were widened beyond 30 inches. The profits likewise were reduced when the plant spacings was as wide as 40 inches. The data show that, unlike the Dennis field that year, this field gave as good net return from 10-inch spacing when used with 500 pounds fertilizer as when used with 1000 pounds fertilizer.

In 1941 the Vaughn field used for these experiments was a moderately fertile Orangeburg fine sandy loam that had grown a spring crop of oats, and at the time of land preparation and planting the soil was dry and in poor physical condition. The plants grew off very slowly until rains occurred in July. The data in table 5 show that low yields resulted. No treatment showed a profit and all showed losses of considerable size.

The experiments were planted in 1942 on two soils at the Ellisville Junior College farm, one an upland soil classified as Ruston fine sandy loam,

Table 5. The influence of the rate of 6-8-8 fertilizer and of plant spacing upon yield and profit from Triumph sweetpotatoes grown in 1941.

Fertilizer rate, pounds to the acre	Hill spacing in inches	Bushels to the acre			Profit to the acre
		Jumbo and No. 1	No. 2 and Culls	Total	
		Dennis field, planted May 9			
500	10	164	68	232	$ 8.92
500	20	182	55	237	26.75
500	30	135	43	178	14.45
500	40	168	33	201	24.09
1000	10	244	62	306	22.14
1000	20	237	45	282	31.28
1000	30	245	40	285	37.54
1000	40	238	40	278	38.56
		Joplin field, planted May 13			
500	10	239	62	301	29.58
500	20	271	47	318	51.01
500	30	177	39	216	25.83
500	40	150	22	172	15.40
1000	10	267	59	326	28.12
1000	20	228	43	271	27.98
1000	30	237	40	277	35.15
1000	40	195	27	222	21.79
		Vaughn field, planted May 14			
500	10	49	44	93	—29.00
500	20	67	41	108	—11.39
500	30	34	32	66	—19.67
500	40	26	26	52	—21.65
1000	10	67	41	108	—33.45
1000	20	50	43	93	—24.83
1000	30	34	32	66	—28.61
1000	40	24	23	47	—32.10
		Dennis field, planted June 10			
500	10	85	75	160	—3.70
500	20	103	60	163	9.86
500	30	101	40	141	7.42
500	40	93	47	140	9.27
1000	10	156	77	233	9.21
1000	20	124	55	179	5.71
1000	30	130	51	181	10.45
1000	40	123	47	170	9.31
		Dennis field, planted July 12			
500	10	78	55	133	—9.79
500	20	74	41	115	—5.34
500	30	104	37	141	5.64
500	40	120	43	163	13.89
1000	10	139	62	201	1.62
1000	20	113	60	173	3.08
1000	30	93	41	134	—5.40
1000	40	120	38	158	3.45

and the other a terrace soil classified as Cahaba fine sandy loam. On the Ruston soil the planting was on May 6, and the Cahaba fine sandy loam field was planted on June 13. Results of these experiments in 1942 are presented in table 6.

These data show that, as in previous years, the yield from the plantings made in the early part of May greatly exceeded the yield from the plantings made a month later. It is seen from the data that in the June planting some of the treatments produced as many small potatoes as large potatoes, and that the highest total yields were made by the plots having close spacing. The yields were too low for profitable production under the practices and costs assumed in this bulletin. Every treatment showed a calculated loss.

In the planting made on May 6 in 1942 the total yields ranged from 147 bushels from the 500 pounds fertilizer with 40-inch plant spacing, to 269 bushels from the 1000-pound rate with 10-inch plant spacing. While this treatment was by far the best in yield of total and the large size potatoes, it was not the most profitable one. The profits varied from a loss of $2.16 to a gain of $19.54, the latter from 30-inch plant spacing on plots receiving 500 pounds fertilizer.

It is noted from the data in table 6 that with the 500-pound rate of fertilizer the net returns increased considerably with each widening of the plant spacing from 10 to 30 inches. The profit of $7.91 an acre from 40-inch plant spacing with this fertilizer rate was much less than that from the 30-inch spacing. At the 1000-pound rate of fertilizer application the results from the different plant spacings were unlike those in connection with the 500-pound rate. The yields decreased from 269 bushels to 179 and to 154 bushels to the acre, and the net returns from $11.05 to $0.43 and to −$1.69 to the acre, as the plant spacing was widened from 10 to 20 to 30 inches. When the plant spacing was widened to 40 inches the yield was increased by 22 bushels, and the returns from a loss of $1.69 to a gain of $8.01. These differences are large enough to be of considerable importance to growers.

In 1942 there was an excess of rainfall at the Ellisville farm during the months of August and September. It was double that for the same months for the average of 1902-1941. This high rainfall had the effect of considerably reducing the yields of the plots planted June 13 on the terrace soil. The data show that only two treatments, those having 10-inch plant spacing, made more than 100 bushels total yield per acre.

Table 6. The influence of the rate of 6-8-8 fertilizer and of plant spacing upon yield and profit from Triumph sweetpotatoes grown in 1942.

Fertilizer rate, pounds to the acre	Hill spacing in inches	Bushels to the acre			Profits to the acre
		Jumbo and No. 1	No. 2 and Culls	Total	
Ellisville field (Ruston soil) planted May 6					
500	10	133	62	195	$—2.16
500	20	118	49	167	5.78
500	30	134	61	195	19.54
500	40	113	34	147	7.91
1000	10	219	50	269	11.05
1000	20	142	37	179	0.43
1000	30	122	32	154	—1.69
1000	40	137	39	176	8.01
Ellisville field (Cahaba soil) planted June 13					
500	10	52	58	110	—18.67
500	20	18	43	61	—20.69
500	30	31	52	83	—9.95
500	40	36	37	73	—10.80
1000	10	55	80	135	—20.14
1000	20	38	42	80	—23.94
1000	30	51	46	97	—14.70
1000	40	45	54	99	—11.96

Average Results

In table 7 data are presented to show the average yields and calculated profits from the rates and spacing experiments discussed in the previous paragraphs. Ten of these experiments were planted from May 1 to May 15, and six were planted from May 16 to July 12. The data on total yield are also illustrated by the curves in figure 6.

Examination of the curves in figure 6 shows that the early planted tests greatly outyielded the late planted, and that 1000 pounds of fertilizer outyielded the 500-pound rate at all plant spacings, whether planted early or late. There was less difference between the two fertilizer rates when planted early at close spacings than at wide spacings. The reverse was true for the average of the late plantings; that is, there was very little difference in yield between the two rates at wide spacings when planted late, but the 1000-pound rate considerably outyielded the 500-pound at close spacings when planted late.

Referring to the data in table 7, it is seen that in the early planted tests, the total yield ranged from 187 bushels per acre from 500 pounds fertilizer with 40-inch plant spacing, to 272 bushels from the 1000-pound rate with 10-inch plant spacing. However, this highest yield was only 12 bushels greater than that obtained from applying 500 pounds fertilizer with 10-inch plant spacing. The same treatment also led in the production of larger size potatoes, with 206 bushels of the Jumbo and No. 1 grades combined. It is notable that on the average the highest yields of small potatoes were made by the closer spacings on each fertilizer rate.

Profits to the Grower

On the basis of the average yields for 4 years, the calculated profits per acre show that several of the treatment combinations were about the same. The 500-pound rate of fertilizer with 20-inch hill spacing of plants gave a significantly higher net return than any other treatment. It is important to note that the highest total yield did not result in the greatest net return per acre when the tests were averaged.

In terms of net profit to the acre, there was little difference between the 10-, 30-, and 40-inch plant spacings on the 500-pound fertilizer rate in the early planted group. On the 1000-pound rate the 20-, 30-, and 40-inch plant spacings were approximately equal in profit. Con-

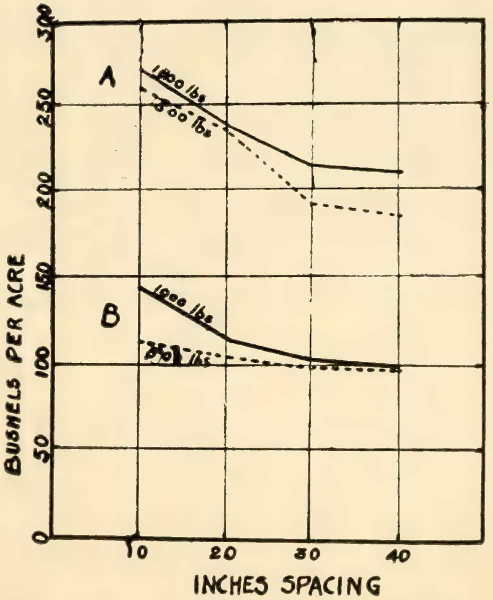

Figure 6. Curves showing 4-year average yields from 6-8-8 fertilizer applied at two rates in connection with different hill spacings of plants; A, average of 10 experiments planted from May 1 to May 15; B, average of 6 experiments planted from May 16 to July 12.

Table 7. The influence of the rate of 6-8-8 fertilizer and of plant spacing upon yield, starch content, and profit from growing Triumph sweetpotatoes, average 1939 to 1942.

Fertilizer rate, pounds to the acre	Hill spacing in inches	Bushels to the acre			Profit to the acre	Percent starch
		Jumbo and No. 1	No. 2 and Culls	Total		
Planted from May 1 to May 15 (10 experiments)						
500	10	191	69	260	$17.31	24.43
500	20	181	55	236	26.45	24.21
500	30	142	52	194	19.24	24.30
500	40	144	43	187	19.90	24.25
1000	10	206	66	272	11.95	23.84
1000	20	188	50	238	18.10	23.30
1000	30	171	44	215	16.58	23.10
1000	40	168	43	211	18.49	22.64
Planted from May 16 to July 12 (6 experiments)						
500	10	57	54	111	—20.75	25.61
500	20	60	44	104	—10.28	25.62
500	30	60	37	97	—8.27	24.56
500	40	60	36	96	—8.87	25.09
1000	10	86	57	143	—19.97	24.57
1000	20	68	45	113	—16.54	23.87
1000	30	65	38	103	—15.61	23.57
1000	40	62	36	98	—14.92	23.41

sidering the individual hill spacings of plants it is seen that under the conditions of these experiments the 10-inch spacing was much less profitable when used in connection with 1000 pounds of fertilizer than when used with 500 pounds. The 20-inch was also more profitable with 500 pounds than with 1000 pounds but the wider spacings gave about the same amount of net return with either rate of fertilizer application.

In the six late planted experiments the data show that the yields were low, in fact too low for a single profit to be possible from a calculation for any of the treatments. The calculated losses vary from about $8.00 an acre to more than $20.00 an acre. These losses are too great for a grower to run the risk of planting later than May 15 for starch production.

It is of interest to point out that in the late planted tests the higher yields were made on the closer spaced plots, on both fertilizer rates. It is also notable that about half of the potatoes were classed as "small" in size or No. 2 and cull grades combined.

Labor Required and Income from Various Treatments

Because there is much difference in the labor required for growing sweetpotatoes by various hill spacings and fertilizer rates, it is important in studying the results of these experiments to note the data in table 8.

It is seen from these data that the labor required is proportional to the total yield. However, the yield per man hour did not vary greatly, ranging from 2.22 to 2.95 bushels. In net labor income per man hour—that is, the value of sweetpotatoes less all costs except labor, divided by the hours per acre—the range was from 36.4 cents for the 1000-pound fertilizer rate with 10-inch plant spacing (the highest yielding plot) to 55.0 cents for the 500-pound rate with 30-inch plant spacing (the next to the lowest treatment in total yield). At the 500-pound fertilizer rate, the 10-inch plant spacing made a considerably lower income per man hour than the 30-inch, and the wider spacings gave approximately the same return per man hour. Also at the 1000-pound rate, the 10-inch plant spacing made much less return per man hour than the 20- and the 30-inch. The 40-inch spacing slightly exceeded the 20-inch and 30-inch.

It has already been pointed out that no net profit to the acre could be calculated on the average yields from the plantings of these tests made after May 15. The data in table 8 show, however, that there is actually a possible income for labor, although it is much lower than is shown for the same treatments planted during the first half of May. The production in potatoes per man hour of labor is about half that obtainable from early planting. These late planted plots also show a very low rate of return per man hour, ranging from slightly less than 2 cents an hour to nearly 15 cents an hour. At the late plantings, the data show that the wider spacings and the 500-pound rate of fertilizer application gave the highest return per hour of labor. At the higher fertilizer rate, the 10-inch plant spacing gave the highest return per man hour.

Fertilizer Placement

In table 9 data are presented to show 3 years' average results from varying the placement, with respect to the plants, of 500 pounds of 6-8-6 fertilizer, the application being made at the time of the transplanting except in A and B. The placements referred to in table 9 are illustrated in figure 7. The "starter" solution used in these experiments was made as follows: 4 pounds of 20.5 percent ammonium sulfate, 16 pounds of 18 percent superphosphate, and 4 pounds of 50 percent muriate of potash were mixed and placed in a cotton cloth bag and suspended with frequent stirring at least 3 hours in a barrel containing 24 gallons of water. The stock solution thus made was used as a dilution of 1 gallon in 50 gallons of water and applied at a rate of approximately 1 pint per plant.

During the 3 years there were four of these experiments planted between May 1 and 15, three between June 10 and 15, and two between July

Table 8. Yield, profit, labor income, and return per man hour from growing Triumph sweetpotatoes for starch with various fertilizer rates and hill spacings, based on average yields of 1939-1942.

Fertilizer rate, pounds to the acre	Hill spacing (inches)	Total yield (bushels to the acre)	Profit to the acre	Man hours to the acre	Bushels per man hour	Labor income per acre	Net income per man hour (cents)
Planted from May 1 to May 15 (10 experiments)							
500	10	260	$17.31	117.2	2.22	$46.89	40.0
500	20	236	26.45	86.8	2.72	47.75	55.0
500	30	194	19.24	74.5	2.60	37.44	50.2
500	40	187	19.90	69.0	2.70	36.65	53.1
1000	10	272	11.95	118.9	2.29	42.29	36.4
1000	20	238	18.10	87.8	2.71	39.97	45.5
1000	30	215	16.58	76.7	2.80	35.70	46.5
1000	40	211	18.49	71.4	2.95	35.85	50.2
Planted from May 16 to July 12 (6 experiments)							
500	10	111	—20.75	90.8	1.22	3.22	3.5
500	20	104	—10.28	69.3	1.50	7.50	10.8
500	30	97	—8.27	61.8	1.57	7.63	12.3
500	40	96	—8.87	58.0	1.66	8.43	14.5
1000	10	143	—19.97	93.8	1.52	4.97	5.3
1000	20	113	—16.54	69.8	1.62	1.95	2.8
1000	30	103	—15.61	63.1	1.63	1.13	1.8
1000	40	98	—14.92	59.2	1.66	1.72	1.9

Table 9. Influence of the placement of 500 pounds 6-8-6 fertilizer with transplanter attachment at planting time upon yield, starch content, and profit from growing Triumph sweetpotatoes in 1940, 1941, 1942.

Fertilizer placement	Bushels to the acre			Profit to the acre	Percent starch
	Jumbo and No. 1	No. 2 and Culls	Total		
Planted from May 1-15 (4 experiments)					
A. Furrow, bedded upon	142	35	177	$21.69	24.86
B. Side, level with plant roots	156	39	195	27.15	25.36
C. Side, shallow one side, deep other	148	41	189	25.51	25.92
D. Side, plus "starter" solution	152	34	186	24.07	25.66
E. "Starter" solution plus top dress fertilizer 3 weeks later	131	40	171	19.14	25.09
F. Superphosphate and dolomite each at 222 lbs. per acre in furrow, plus "starter" solution, plus top dress 6-0-6 three weeks later	130	40	170	18.19	25.79
Planted from June 10-15 (3 experiments)					
A. Furrow, bedded upon	47	89	136	21.19	24.44
B. Side, level with plant roots	58	37	95	4.72	22.87
C. Side, shallow one side, deep other	53	37	90	2.73	23.58
D. Side, plus "starter" solution	54	50	104	7.79	23.45
E. "Starter" solution plus top dress fertilizer 3 weeks later	76	38	114	—1.49	25.25
F. Superphosphate and dolomite each at 222 lbs. per acre in furrow, plus "starter" solution, plus top dress 6-0-6 three weeks later	69	33	102	—3.99	25.57
Planted from July 1-20 (2 experiments)					
A. Furrow, bedded upon	—	—	70	—14.23	21.60
B. Side, level with plant roots	—	—	81	—11.03	20.58
C. Side, shallow one side, deep other	—	—	75	—12.73	22.11
D. Side, plus "starter" solution dress fertilizer 3 three weeks later	—	—	64	—11.39	22.69
E. "Starter" solution plus top	—	—	73	—13.70	20.46
F. Superphosphate and dolomite each at 222 lbs. per acre in furrow, plus "starter" solution, plus top dress 6-0-6 three weeks later	—	—	62	—17.94	20.14

1 and 20. Table 9 shows the data for these three groups of tests separately.

These results show that the time of planting and the location of the fertilizer application had considerable effect upon the yield. Fertilizer placement had more effect when the crop was planted early. The higher total yields were usually associated with the higher yields of No. 1 and Jumbo size potatoes. The placement of the fertilizer used in these experiments in a band of 3 inches on each side of and about on a level with the plant roots at the time of transplanting, was the best from the standpoint of net profits and total yield. This placement was much better in yield and profit than the placement of all the fertilizer under the row several days before planting (A in figure 7); or all of it, except "starter" solution, as a top-dressing 3 weeks after planting (E in figure 7); and was likewise superior to the treatments in which phosphate and dolomitic limestone were applied under the row before planting, plus "starter" solution at planting and plus nitrogen and potash top-dressed 3 weeks after planting. This "side" placement (B in figure 7) was not better in yield by any considerable amount than when placed deep on one side and shallow on the other (C in figure 7), nor when "starter" solution was applied in addition (D in figure 7). Considerably more labor is required for the extra operations necessary for the split applications made at times other than at transplanting. This fact and the greater yields caused the side placement to be several dollars more profitable.

In the June planted group of these placement experiments, shown also in table 9, the yields and calculated profits were much lower than from the same treatments when planted a month earlier. Also the same treatments did not lead in yield or profit. The two treatments resulting in highest yields in the early-planted group were the two lowest in the June-planted group. It is not known why this is true. Because of the low yields, low profits were made on the June plantings, ranging from about $4.00 loss to $21.19 gain.

Only two experiments were planted in July, and the data in table 9 show that these averaged very low yields. All treatments in this group showed calculated losses.

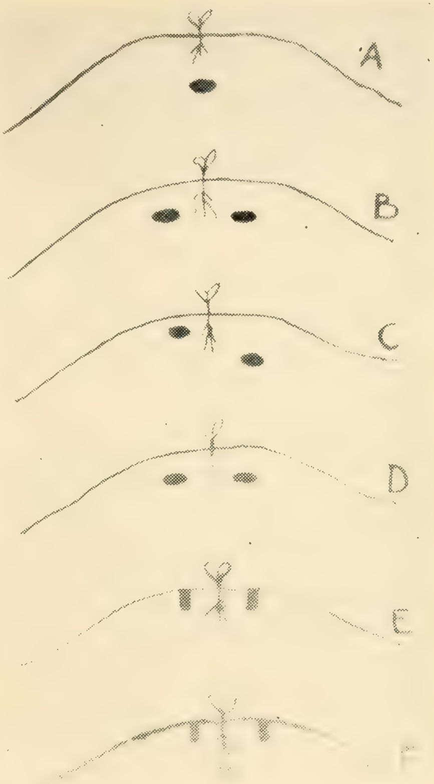

Figure 7. Illustration of placement of fertilizer in relation to the plants by transplanter attachments at time of transplanting; A, Furrow, bedded upon; B, Side, level with plant roots; C, Side, shallow one side, deep other; D, Side, plus "starter" solution; E, "Starter" solution plus top-dressed fertilizer 3 weeks later; F, Superphosphate and dolomite each at 222 pounds per acre in furrow, plus "starter" solution, plus top-dressed 6-0-6 three weeks later.

Placement of Fertilizer With Tractor Cultivator

In table 10, data are presented to show the average of 2 years' results from various placements of 800 pounds of 6-8-8 fertilizer, by using tractor cultivator attachments and applying the fertilizer during the ridging of the land before transplanting. Included also is the placement under "C" in the table where the application was with transplanter attachments at planting time; that is, it was the same as the "B" placement in table 9. These fertilizer placements are illustrated by the drawings in figure 8.

The data in table 10 show that there was great difference between the different placements of the fertilizer in the total yield and in the yield of large potatoes. The yields ranged from 152 bushels from placing in bands 2½ inches from the plants before transplanting ("B" placement) to 234 bushels from applying the fertilizer with transplanter attachments at the time of planting in bands 3 inches on each side of the plants. This is the same type of placement that led in the data reported in table 9 for 500 pounds of 6-8-6, applied at transplanting time. This treatment was better than all others by a significant amount. Placement in the center of the row under the plants before planting and in bands 7½ inches on each side were alike in total yielding ability. These two treatments were considerably better in yielding than placement in bands 2½ inches or 10 inches on each side of the plants.

Apparently, when the fertilizer is placed too near the plant roots on either side some injury occurs and the yield is reduced; and when it is placed too far away from the plants, insufficient benefit is derived by the plants from the fertilizer, thus causing reduced yield due to lack of fertilizer effect early after setting the plants.

Because it has been assumed that the fertilizer could be placed one way as cheaply as another in these experiments, no calculations of indicated differences in net profits were made. Thus, the fertilizer could easily be applied in connection with the ridging of the land with the tractor cultivator disk-hiller attachments, and fertilizer attachments, at a cost practically equal for all the placements.

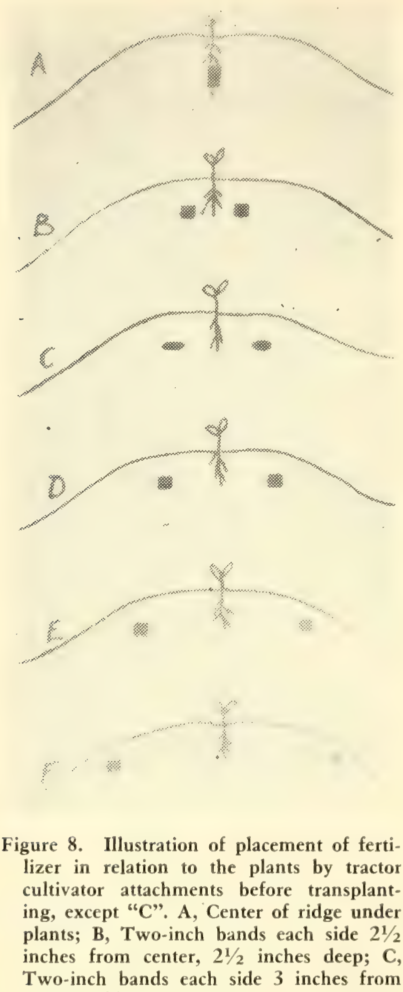

Figure 8. Illustration of placement of fertilizer in relation to the plants by tractor cultivator attachments before transplanting, except "C". A, Center of ridge under plants; B, Two-inch bands each side 2½ inches from center, 2½ inches deep; C, Two-inch bands each side 3 inches from center, 2½ inches deep with transplanter at planting; D, Two-inch bands each side 5 inches from center, 2½ inches deep; E, Two-inch bands each side 7½ inches from center, 2½ inches deep; F, Two-inch bands each side 10 inches from center, 2½ inches deep.

Effect of Fertilizer Rate and Placement and Hill Spacing of Plants on Starch

In table 7 data are presented on the average percent of starch in the potatoes produced by the various rates of fertilizer and hill spacings tried in these experiments. These data show that with any spacing of the plants the 500-pound rate of 6-8-8 made about 1 percent more starch than the 1000-pound rate at both the early and the late plantings. This difference amounts to so small a quantity of starch per acre that it is not believed

Table 10. Influence of the placement of 800 pounds of 6-8-8 fertilizer with tractor and cultivator attachments before planting upon yield and starch content of Triumph sweetpotatoes, average of 1941 and 1942.

Fertilizer placement	Bushels to the acre			Percent starch
	Jumbo and No. 1	No. 2 and Culls	Total	
A. Center of ridge under plants	159	43	201	27.10
B. Two-inch bands each side 2½ inches from center, 2½ inches deep	112	40	152	26.79
C. Two-inch bands each side 3 inches from center, 2½ inches deep at planting	190	44	234	27.43
D. Two-inch bands each side 5 inches from center, 2½ inches deep	176	47	223	26.99
E. Two-inch bands each side 7½ inches from center, 2½ inches deep	152	50	202	25.29
F. Two-inch bands each side 10 inches from center, 2½ inches deep	130	45	175	26.18

important to growers. It is notable, however, that the most profitable treatment in these studies, 500 pounds fertilizer with 20-inch plant spacing, made potatoes having as high a starch content as any other treatment.

In table 9, average data are given showing the percent of starch in potatoes produced by varying the placement of 500 pounds 6-8-6 fertilizer with transplanter at time of planting. These data show that there was no important difference between fertilizer placements at the early, mid-season, or late plantings. There was some variation in the different fields and in different years. The data show that in those fields where these tests were planted, the starch content was lower in the June and July plantings than in the May plantings. This observation agrees with results of other experiments which have shown that the later the planting of sweetpotatoes after the middle of May the lower the starch content.

In table 10, data are presented which show the average starch content of sweetpotatoes produced by varying the placement of 800 pounds of 6-8-8 fertilizer before transplanting, by use of the tractor cultivator attachments. These data show that there was no difference of practical significance in starch content produced by varying the placement of the fertilizer.

SUMMARY

1. Varying the rate of 6-8-8 fertilizer and the hill spacing of plants had different effects upon yield and net return from Triumph sweetpotatoes when grown in different years on fields having different fertility levels.

2. The 1000-pound rate of 6-8-8 fertilizer outyielded the 500-pound rate at all plant spacings whether planted early or late, but this difference was less when early planting was at close spacings than when at wide spacings. There was little difference between the two rates at wide spacings when planted late, but the 1000-pound rate considerably outyielded the 500-pound rate when planted late at the close spacings.

3. The 500-pound rate of fertilizer with a 20-inch hill spacing of plants gave the highest net return.

4. The 10-inch and 20-inch hill spacings of plants were less profitable with 1000 pounds of fertilizer than with 500 pounds, and the 30-inch and 40-inch spacings gave about the same return with either rate of fertilizer.

5. In the late planted tests the higher yields were made by the close spaced plots on both fertilizer rates. Although no profit per acre was shown from late planting, net labor income up to about 15 cents an hour was shown for these plantings. Close spacing did not make up for the harmful effects of late planting.

6. In income per man hour, the 500-pound rate with 20-inch, 30-inch, and 40-inch plant spacings were about equal and exceeded all other treatments except the 1000-pound rate with 40-inch plant spacing.

7. The placement of fertilizer affected the yield, and the placement of 500 pounds of 6-8-6 in bands 3 inches to the side of and on a level with the plant roots at transplanting time was better than all others tried in total yield and net return.

8. "Starter" solutions, supplementary to a complete fertilizer, were of little or doubtful value as used in these experiments.

9. Placement of 800 pounds of 6-8-8 fertilizer with tractor cultivator attachments at or immediately before transplanting in bands 3 inches to the side of and on a level with the plant roots gave higher yields than when placed in the center of the row or on each side in bands nearer to or farther from the plant roots.

10. Varying the rate of fertilizer, varying the hill spacing, and varying the placement of the fertilizer in these experiments had little effect upon the content of starch in the Triumph sweetpotato.

BULLETIN 403 JUNE 1944

Economic and Cost Study of Cotton Ginning IN Central Mississippi

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

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This bulletin is a joint contribution of the Agricultural Economics Department of the Mississippi Experiment Station and the Research and Testing Division, Cotton and Fiber Branch, Office of Distribution, Washington, D. C. The findings presented are the results of work done during the first year on a project that is expected to continue for an indefinite period.

The authors are grateful to Mr. F. L. Gerdes, Dr. John W. Wright, Dr. Frank J. Welch, and Mr. Clyde C. McWhorter for helpful counsel in the development, and throughout the conduct of this project including the preparation of the manuscript. Especial credit is due Mr. W. H. Fortenberry for work done in appraising and evaluating the gin machinery and equipment. The help given by Mr. M. S. Shaw, district agent, Mr. L. C. Murphree, Mr. C. J. Smith, Mr. J. C. Taylor and Mr. F. M. Smith, county agents, was most valuable and is appreciated. Of course this study would not have been possible without the records made available by the ginners and warehousemen in the sample counties. The kindness and patience displayed by these men made the conduct of this study a pleasure.

Appreciation is extended to the General Education Board for grant of funds that made it possible for the Agricultural Economics Department of the Mississippi Experiment Station to participate in this study.

ECONOMIC AND COST STUDY OF COTTON GINNING IN CENTRAL MISSISSIPPI

By D. GRAY MILEY and ARTHUR L. ROBERTS[1]

Since as early as 1906 the number of cotton gins in Mississippi has constantly declined. As will be seen from table 1, there were 3,780 active cotton gins in Mississippi in 1906. This number decreased until in 1943 there were 1,227 active cotton gins operating in the State. This is a reduction of about 67 percent in the number of active gins. While this decrease in number has been taking place, there has been a constant increase in the average number of saws per gin. This indicates that the gins operating at the present time are, on the average, much larger gins than those that were operating 25 years ago. Therefore, the capacity of the ginning equipment has not decreased in anything like the same proportion as the number of gins. Total cotton production in Mississippi was 1,530,748 bales in 1906 and 1,781,926[2] bales in 1943.

When all the gins are converted to the equivalent of 4 gin stands with 80 saws each, it is revealed that there has been only a slight decrease in 4-80 equivalent gins since 1906. The significant fact is that for many years there has been a definite tendency toward a decrease in number of gin plants accompanied by an increase in average capacity per plant.

The ginning industry in Mississippi represents a total investment of approximately $20,000,000. Gins are used on an average of about three months out of each year. The income for the ginning period has to be sufficient to cover interest on the investment and depreciation on the equipment and buildings for the entire year. As will be shown later, this fact places a very great premium on the efficient operation of ginning machinery during the period when it is operating. Farmers of Mississippi pay from $7,000,000 to $8,000,000 a year, depending upon the size of the cotton crop, for ginning services, bagging, and ties. This together with the tremendous investment

Table 1. Ginning facilities in Mississippi, by specified years, 1906-1941.[1]

Year	Number of active gins	Average saws per gin	Number of gins 4/80 equivalent[2]
1906	3,780	121	1,430
1909	3,283	135	1,387
1914	2,359	160	1,176
1919	1,695	185	982
1935	1,292	249	1,094
1940	1,280	264	1,142
1941	1,269	—	—
1942	1,246	—	—
1943	1,227	—	—

[1] **Cotton Production and Distribution, Season of 1919-20,** Bureau of Census, Bulletin 145, pp. 26-43, **Cotton Production in the United States, Crop of 1941,** Bureau of Census, p. 16, **Cotton Ginning Machinery and Equipment for Mississippi, 1935 and 1940.**

[2] Total number of saws divided by 320, the number of saws in a 4/80 gin (a gin with 4 stands and 80 saws per stand).

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[1] Miley, D. Gray, agricultural economist, Mississippi Experiment Station; Roberts, Arthur L., agricultural economist, Research and Testing Division, Cotton and Fiber Branch, Office of Distribution, Washington, D. C.

[2] Preliminary.

involved in ginning equipment, makes the cotton ginning industry one of the most important in the State. The ginning process is the first step that cotton takes after it leaves the farm on its way to the ultimate consumer.

In addition to the cost involved, there is the very important matter of the effect of the ginning machinery on the quality and efficiency of ginning. That the particular type and condition of ginning equipment might have considerable influence on the grade of cotton has long been suspected but has never been studied in any detailed objective manner. For the past several years, there has been a constant decline in the average grade of cotton produced in Mississippi. For example, during the 3-year period from 1928 to 1930, 14.2 percent of the cotton produced in the State graded Good Middling. By way of comparison, during the 3-year period 1939 to 1941 the proportion of cotton grading Good Middling represented only 1.6 percent of the total cotton produced. (Table 2).

Also there was a rather constant decline in the proportion of cotton that graded Strict Middling. On the other hand, the proportion of cotton that graded Middling, Strict Low Middling, and Low Middling has been increasing for the past 15 years. During the earlier period (1928-1930), 55 percent of the cotton graded above Middling; whereas during the latter period (1939-1941), only 19 percent of the cotton produced fell in these higher grades. There are, no doubt, many causes that will explain why there has been a constant decline in the grade of cotton, but it is probable that the ginning machinery and equipment has had something to do with it, particularly insofar as it affects the preparation element of grade.

OBJECTIVES OF THE STUDY

This study was designed for the purpose of determining the influence of ginning machinery and equipment on the cost of ginning cotton and on the quality of cotton ginned. Specifically the objectives of the study were as follows: (1) To determine the comparative economics of ginning cotton at modern and at sub-standard gins taking into account costs of transporting cotton to the gin, charges paid for ginning services, and grades and staple length obtained; (2) to determine the comparative costs of performing the ginning services at modern and sub-standard gins; and (3) to determine what adjustments in ginning and in marketing procedures are required to provide cotton growers financial incentive to produce and market cotton of the quality required by cotton manufacturers.

Table 2. Percentage distribution of cotton ginned in Mississippi, according to grade, average by periods, 1928-1941.

Grade	1928-30 percent	1931-32 percent	1933-35 percent	1936-38 percent	1939-41 percent
Middling Fair	—	—	—	—	—
Strict Good Middling	.3	—	—	—	—
Good Middling	14.2	4.9	10.2	5.5	1.6
Strict Middling	40.3	42.6	49.8	29.4	17.2
Middling	29.9	35.5	30.2	31.3	41.2
Strict Low Middling	9.8	11.3	8.8	22.9	31.5
Low Middling	3.5	2.7	1.0	7.5	7.2
Strict Good Ordinary	1.4	2.0	—	2.2	1.0
Good Ordinary	.6	1.2	—	1.0	.3
Total	100.0	100.0	100.0	100.0	100.0

METHOD OF STUDY

For the first year a rather limited area embracing Winston, Neshoba, Newton, and Leake Counties was selected for preliminary intensive study. This area was selected mainly because of the fact that a large number of the gins were in one variety cotton communities and had Smith-Doxey classification that made it possible to get a rather complete check on the quality of ginning being done.

After selecting the area, a preliminary field survey was made of all gins for which an official classification of the cotton ginned was available. This preliminary survey provided information about the size of the gin plant, the equipment available, the volume of cotton expected to be ginned during the 1943 season, the variety of cotton produced by patrons of the gin, and the approximate age and condition of equipment. On the basis of these data, a tentative selection of gins to be used in the comprehensive study was made.

The gins selected for the comprehensive study were visited by a specialist from the United States Cotton Ginning Laboratory and a detailed appraisal made of each gin plant. This appraisal was for the purpose of determining the ability of the equipment to gin cotton from the standpoint of quality obtained. On the basis of this appraisal, the gins were divided into three groups: (1) the group which is called modern gins in this study, embraces those gins that have the equipment to perform an efficient job of ginning; (2) the group which is called average gins, is as the name implies, that group of gins that is equipped to do a fair job of ginning; and (3) the group which is called sub-standard gins are those gins that because of the type and condition of the equipment were not in position to do a good or even fair job of ginning cotton. There were 10 modern gins, 15 average gins, and 18 sub-standard gins for which complete information was obtained.

After making these classifications, the gins were visited at the close of the season and detailed cost data were obtained for the 1943 ginning season. The official classification for all samples sent from each of the gins was obtained from the official grade sheets of the United States Department of Agriculture classing office in Jackson. Because of the difficulty of tracing gin bale numbers through the warehouses to the records of the cotton buyers, it was not possible to get a representative sample of the bales of cotton that were actually sold for which official classification was available.

In order to get the distances cotton was hauled, a sample of patrons was taken from the books of each gin. These patrons were later located on an official county map and the actual distance to the gin recorded. In addition to furnishing the information as to distance hauled, these maps were used as a basis for getting the physical layout of the entire territory.

GENERAL CHARACTERISTICS OF THE GINS

Complete information was obtained from 43 gins. The location of these gins is shown in figure 1. There was a total of 45,292 bales of cotton ginned by these 43 gins during the 1943 ginning season. (Table 3). This is an average of 1,053 bales per gin. However the modern gins had a considerably larger volume than either of the other two groups. The size of the gin plant was very nearly the same for the average and modern gins but averaged about one gin stand smaller for the sub-standard gins.

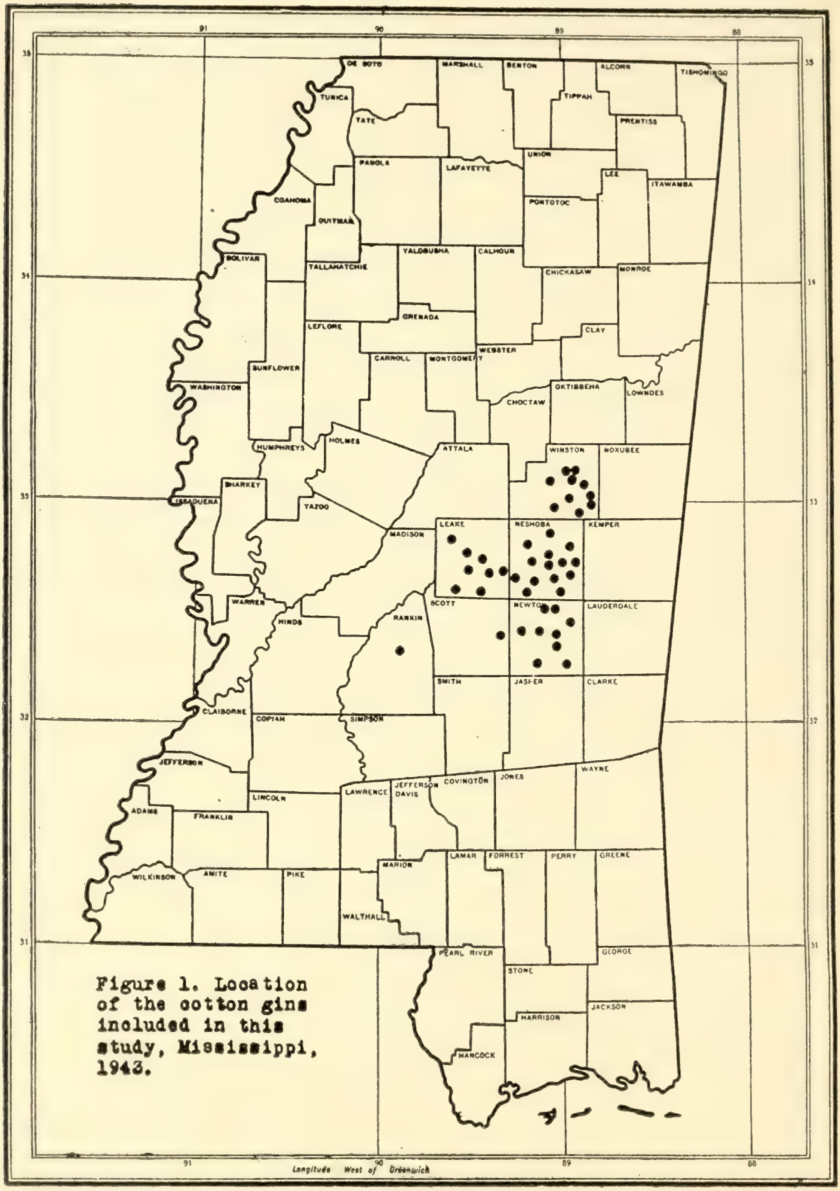

Figure 1. Location of the cotton gins included in this study, Mississippi, 1943.

Table 3. The number, volume, size, capital investment, and other factors of general information about the groups of gins included in this study, Mississippi, 1943.

Item	Modern gins	Average gins	Sub-standard gins	Average all gins
Number of gins	10	15	18	43
Volume:				
Total bales ginned	16038	15058	14196	45292
Bales per gin	1604	1004	789	1053
Bales per gin stand	458	279	290	328
Size:				
Total number of gin stands	35	54	49	138
Stands per gin	3.5	3.6	2.7	3.2
Capital investment:				
Estimated replacement value, dollars	$255553.70	$349865.77	$334527.23	$939946.70
Estimated present value, dollars	161267.42	189063.72	155191.75	505522.89
Replacement value per gin, dollars	25555.37	23324.38	18584.85	21859.22
Present value per gin, dollars	16126.74	12604.25	8621.76	11756.35
Percent present is of replacement value	63	54	46	54
Present value per stand, dollars	$ 4607.64	$ 3501.18	$ 3167.18	$ 3663.21
Present value per bale ginned, dollars	$ 10.69	$ 13.97	$ 13.30	$ 12.93
Average charge for ginning—cents, per cwt. of seed cotton	26.2	28.1	28.0	27.6

The difference in the estimated replacement value of the gins in these groups was not as great as the difference in the estimated present value at the time the study was made. The present value was 63 percent of the replacement value for the modern gins and only 46 percent for the sub-standard gins. This indicates that the gins in the sub-standard group were older and had depreciated more in value than had those in the modern group.

When the capital investment was put on the basis of value per bale ginned, it was revealed that the modern gins had a smaller amount of investment per bale than did the gins in either of the other groups.

The average charge for the ginning service averaged about $0.02 per cwt. of seed cotton lower for the modern gins than for the gins in the other two groups. These general characteristics about the groups of gins should be kept clearly in mind throughout the analysis that is to follow.

FINANCIAL SUMMARY

A detailed summary of the average expense and income of each of the three groups of gins as well as all gins combined is shown in table 4. The various costs are given separately and are grouped according to the type of cost. That is, current expenses are given separately from management and investment costs. It will be observed that in the group of current expenses the labor bill was by far the most important for all groups of gins. Other important items of expense were fuel or power costs, insurance, taxes, and maintenance and repairs. All current expenses were higher for the modern gins than they were for either of the other groups and averaged $2,122 for the 43 gins combined. The salary for management also was highest for the modern gins and lowest for the sub-standard gins, averaging around $378 for all gins combined.

The two items of depreciation and interest, which make up the investment costs, were very important for all groups of gins. Interest on the capital investment was figured at the conservative rate of 4 percent. Depreciation was figured at 5 percent of all items except the gin buildings which were

Table 4. Summary of average expenses and income for 43 gins, by groups, according to the condition of the ginning equipment, Mississippi, 1943.

Item	10 Modern gins	15 Average gins	18 Sub-standard gins	All 43 gins
Current expenses:				
Labor	$1294.42	$ 875.06	$ 786.27	$ 935.42
Fuel or power	408.22	223.14	209.03	260.28
Materials (oils, greases, etc.)	50.57	58.85	54.90	55.27
Insurance	343.24	259.40	178.66	245.10
Taxes	227.45	171.94	106.07	157.28
Maintenance and repairs	385.35	281.29	208.54	275.04
Other costs	372.58	166.68	117.24	193.87
Total current expenses	$3081.83	$2036.36	$1660.71	$2122.26
Salary for management	$ 568.52	$ 351.50	$ 293.72	$ 377.78
Investment costs:				
Depreciation	$ 765.85	$ 605.18	$ 412.53	$ 561.90
Interest (4 percent)	645.07	504.17	344.87	470.25
Total investment costs	$1410.92	$1109.35	$ 757.40	$1032.15
Total cost	$5061.27	$3497.22	$2711.83	$3532.19
Fees for ginning	$5228.51	$3516.50	$2738.09	$3588.80
Profit on ginning operation	$ 167.24	$ 19.28	$ 26.26	$ 56.61
Net income from cottonseed	$1568.44	$1001.64	$ 617.02	$ 972.45
Net income from bagging and ties	$ 400.34	$ 261.03	$ 196.91	$ 266.59
Net profit	$2136.02	$1281.95	$ 840.19	$1295.65

figured for the most part at 3 percent. These are not cash costs but are nevertheless costs that have to be met by any industry or by any individual in that industry if the industry or the individual is to continue any length of time. Certainly if capital cannot receive a reasonable return from the ginning industry, it is not going to flow freely in that direction. If a person with capital can invest it elsewhere and get 3 or 4 percent interest without putting out any great amount of effort there is no particular inducement for him to put his money in the ginning industry, take all the risks involved, and hope to get a reasonable return on the money invested. From this standpoint interest on the investment like depreciation is a definite cost that the ginning industry has to bear over a long period of time if it is to maintain itself.

Any individual in the ginning business has the interest on the investment, the amount allowed for depreciation and in some cases, the salary for management as cash that he can use for any particular year. However, if this amount is used without making proper allowances for the replacement of the plant, the plant itself usually goes out of existence when it is worn out. In other words, the operator has "lived up" his capital investment and if any large proportion of the operators in the ginning industry have to live in this manner the industry itself gradually goes down. That is, unless these investment and management costs are properly cared for by a majority of the individuals in the industry, it is impossible for the general level of the group to be improved from year to year.

Net profit, as used in this report, is the amount left after all costs have been accounted for, including a salary for management, depreciation, and interest on the investment. In order words, a reasonable return is allowed for all the factors of production and anything that is left is called net profit. When used in this sense, net profit is not necessary for the indefinite maintenance of the industry. That is, if the operators could pay themselves a fair salary, take care of their depreciation and get a reasonable return on their investment they could continue in the ginning business indefinitely.

When the 43 gins included in this study are considered as a group, the net profit on the ginning operation amounted to an average of about $57 per gin. This means simply that the average gin operator had an allowance for a salary of an average of $378; that he was allowed an average of $562 for depreciation on his gin plant; that he got a return of $470 or 4 percent interest on the amount of capital he had invested, and in addition had $57 net profit. The net profit for the 10 modern gins averaged $167 per gin, which was somewhat higher than the profit for the other two groups. It can be said that as a group these gins maintained themselves and paid fairly reasonable returns for the amount of time put in by the operators. This was done entirely by the ginning operation.

In compiling these summaries the entire cost of the operation was charged to the ginning part of the business. This was done because of the obvious difficulties involved in trying to allocate the costs between the ginning of cotton, the handling of cottonseed, and bagging and ties.

For the cottonseed operation, the difference between the cost of cottonseed handled and the price obtained was taken as the net income from the cottonseed operation. The net income from bagging and ties was handled in the same manner. When the income from these operations is added to the profit from the ginning operations, these 43 gins had an average net profit of $1,296. This figure ranged from $2,136 for the 10 modern gins to $840 for the 18 sub-standard gins.

COST AND INCOME PER BALE

When the cost of ginning is put on a per bale basis, the gins in the modern group have somewhat lower cost than those in the other two groups. (Table 5.) This probably accounts for the fact that the modern gins made a smaller charge for the ginning services. The average current expenses for 10 modern gins was $1.92 per bale while for the 18 sub-standard gins the average was $2.11 per bale. The average management cost was $0.36 per bale for all gins and did not vary significantly between the three groups of gins. The investment costs were lowest for 10 modern gins and highest for the 15 average gins with an average of $0.98 per bale for all gins combined. The average total cost, including salary for management, depreciation, and interest on the investment, for ginning a bale of cotton for the 43 gins was $3.35; the average fee for ginning a bale of cotton was $3.41, thus leaving a net profit on the ginning operation of $0.06 per bale. There was an averag net income of $0.92 per bale from cottonseed and $0.25 per bale from bagging and ties. Therefore, the net profit per bale for all the gins was $1.23. The net profit ranged from $1.24 for the 10 modern gins to $1.06 for 18 sub standard gins.

In summary it can be safely said that during 1943 from the standpoint o total expense and income as well as the cost and income per bale that th ginning operation maintained itself including a fairly reasonable allowance fo interest, depreciation and management costs, and that the additional incom

Table 5. Summary of the cost and income per bale of cotton ginned for 43 cottton gins, by groups, according to the condition of the ginning equipment,* Mississippi, 1943.

Item	10 Modern gins	15 Average gins	18 Sub-standard gins	All 43 gins
Current expenses:				
Labor	$0.81	$0.87	$1.00	$0.89
Fuel or power	.26	.22	.27	.25
Materials (oils, greases, etc.)	.03	.06	.07	.05
Insurance	.21	.26	.23	.23
Taxes	.14	.17	.13	.15
Maintenance and repairs	.24	.28	.26	.26
Other costs	.23	.17	.15	.18
Total current expenses	$1.92	$2.03	$2.11	$2.01
Salary for management	$ .35	$ .35	$ .37	$ .36
Investment costs:				
Depreciation	$ .48	$ .60	$ .52	$ .53
Interest (4 percent)	.40	.50	.44	.45
Total investment cost	$ .88	$1.10	$ .96	$ .98
Total cost	$3.15	$3.48	$3.44	$3.35
Fees for ginning	$3.26	$3.50	$3.47	$3.41
Profit on ginning operation	$ .11	$ .02	$ .03	$ .06
Net income from cottonseed	$ .98	$1.00	$ .78	$ .92
Net income from bagging and ties	$ .25	$ .26	$ .25	$ .25
Net profit per bale	$1.34	$1.28	$1.06	$1.23

provided by the cottonseed and bagging and ties operations provided a net profit of a substantial amount for the average gin included in this study.

None of the modern gins showed a net loss on all operations. Two of the average gins had an actual net loss; whereas seven of the sub-standard gins had a net loss on all operations. In other words, 9 of the 43 gins had a net loss during the 1943 season.

LABOR AND FUEL REQUIREMENTS FOR GINNING

The average hours of labor required to gin a bale of cotton was 3.1 for all gins combined. (Table 6). This ranged from an average of 2.6 hours at modern gins to 3.7 hours for sub-standard gins. This figure includes the amount of time spent by the manager. In most instances the manager was also the owner, the ginner, the bookkeeper, and the engineer. In such cases it was obviously very difficult to make any separation between the actual amount of time spent in management and the amount of time spent in the actual running of the gin. Because of this situation and the fact that a large proportion of the gins studied were individually owned and operated, an attempt was made to convert the management labor to an hourly basis.

The power for operating the gin machinery was obtained from oil burning engines for 24 of the 43 gins. These 24 gins burned an average of 1.9 gallons of fuel oil per bale of cotton ginned. When compared by groups, the amount used by modern gins was 1.6 gallons per bale as compared to 2.2 gallons for the sub-standard gins.

There were nine gins that were powered by gasoline burning engines. These gins used an average of 2.8 gallons of gas per bale of cotton ginned. As was the case with the other groups, the amount of gasoline used by the modern gins was less than that burned by the other two groups of gins.

Table 6. Quantities of labor and fuel used in the ginning operation, by groups of gins, Mississippi, 1943.

Item	Modern gins	Average gins	Sub-standard gins	Average all gins
Hours of labor:				
Number of gins	10	15	18	43
Management[1]	1136	703	587	755
All other	3084	2385	2303	2513
Total	4220	3088	2890	3268
Per bale of cotton	2.6	3.1	3.7	3.1
Fuel oil:				
Number of gins	5	8	11	24
Gallons per gin	2801	1806	1914	2063
Gallons per bale	1.6	1.8	2.2	1.9
Gasoline:				
Number of gins	2	4	3	9
Gallons per gin	2785	3008	2117	2661
Gallons per bale	2.3	3.0	3.1	2.8

[1] The hours of management labor were computed on the basis of a rate of 50 cents per hour for all management time.

FACTORS THAT INFLUENCE GINNING INCOME

Size and Volume

In order to show the influence of the volume of cotton ginned on the income of the ginning operation, all gins were divided into groups according to the number of gin stands, and then each of these groups further divided according to the number of bales ginned. The results of this tabulation are shown in table 7.

There were three 2-stand gins that ginned less than 500 bales of cotton. The average was 321 bales per gin. These three gins had a net loss of $3.07

Table 7. The relationship of the number of bales of cotton ginned to the cost, income, and other factors of gin operation for various sizes of gins, Mississippi, 1943.

Size and volume	No. of gins	Bales per gin	Total cost-per bale	Net income per bale	Net income per gin	Hours of labor per bale
2 stands:						
Bales ginned:						
Under 500	3	321	$6.98	$ –3.57	$ –1017.49	6.72
500 - 800	5	668	3.46	.01	23.17	4.32
Over 800	3	1138	3.13	.13	271.64	1.97
3 stands:						
Bales ginned:						
Under 600	6	476	$5.58	$ –2.13	$ –1058.31	5.16
600 - 1000	7	882	3.33	.22	207.08	3.20
Over 1000	8	1214	2.92	.50	590.02	2.71
4 or more stands:[1]						
Bales ginned:						
Under 1400	4	1303	$3.35	$ .10	$ 126.69	2.85
1400 - 1800	3	1675	3.08	.19	334.97	2.70
Over 1800	4	2150	3.06	.33	808.54	2.87

[1] There are seven 4-stand gins, two 5-stand, one 7-stand, and one 8-stand gins in this group.

per bale for every bale ginned, or an average of over $1,000 net loss per gin. They required an average of 6.7 hours of labor per bale of cotton ginned. On the other hand, there were three other 2-stand gins that ginned an average of 1,138 bales. These gins had a net profit of $0.13 per bale for every bale ginned, or a net profit of $272 per gin. They spent an average of just under 2 hours of labor per bale of cotton ginned. There were five gins that had an average of 668 bales per gin and whose financial returns fall in between the two extremes just mentioned.

The relationship of the volume to the cost and income for the other size groups are just as striking as those mentioned for the 2-stand gins. Low volume 3-stand gins lost an average of $2.13 per bale, whereas the higher volume 3-stand gins had a net profit of $0.50 per bale. The large gins with a low volume made a profit of $0.10 per bale; while the large gins which also had a large volume had an average net income of $0.33 per bale. There was, therefore, for all sizes of gins, a definite relation between the bales ginned and the per unit cost of operation as well as the net income per bale and per gin.

Efficiently operated small gins with a large volume made a rather substantial net profit on their operations. Of course, they did not make as much as 3- or 4-stand gins with large volumes; but the fact remains that regardless of size, if a gin plant is well balanced between its power plant and other ginning equipment and has a large enough volume for efficient operation, its income will come nearer showing up on the profit side of the ledger than will those gins with the same equipment that have a lower volume of ginning.

Use of Labor

As a usual thing the larger the volume ginned the more efficient will be the use of labor. It was shown in table 7 that for each size group those with the low volumes almost always had the highest number of hours of labor per bale of cotton ginned. In order, therefore, to show the real effect of the efficient use of labor on the cost of ginning, it was necessary to hold the volume ginned as nearly constant as possible. When volume is held constant, some indication of the true relationship between the efficient use of labor and the cost of ginning can be shown.

For this purpose all gins were grouped on the basis of the number of bales ginned and then regrouped according to the hours of labor per bale of cotton ginned. The results of this tabulation are shown in table 8. The gins that had an average volume of less than 800 bales and required an average of 3.3 hours of labor per bale had a net loss of $0.87 per bale; whereas those gins with about the same volume but which had an average of 6.3 hours of labor per bale lost an average of $2.25 per bale. In other words, these were about the same size gins that ginned nearly the same number of bales of cotton, the main difference being that one group used almost twice as much labor per bale of cotton ginned as the other group. Both groups lost money but the group that used labor most efficiently as measured by the hours spent in ginning a bale of cotton lost far less money than the group that had a very inefficient use of labor. The same relationship is shown for the two other volume groups. The gins that had a volume of from 800 to 1,275 bales and an average of around 1,000 bales per gin but with a variation in the hours of labor used, showed a net income in favor of the gins that used the least labor per bale of cotton. Likewise the group of gins with the largest volume

Table 8. The relationship of the hours of labor per bale of cotton ginned to the cost, income, and other factors of gin operation for various volume groups, all sizes of gins combined, Mississippi, 1943.

Group	No. of gins	Bales per gin	Hours of labor per bale	Total cost per bale	Net income per bale	Net income per gin	Average number of gin stands
Ginned less than 800 bales:							
Hours per bale:							
2.13 - 4.40	7	536	3.33	$4.18	$ –0.87	$ –393.68	2.6
4.41 - 10.06	8	523	6.33	5.74	–2.25	–815.18	2.4
Ginned 800 - 1275 bales:							
Hours per bale:							
1.52 - 2.60	7	1015	1.95	$3.04	$ .35	$ 377.71	2.9
2.61 - 5.96	8	1049	3.65	3.38	.25	286.70	3.1
Ginned over 1275 bales:							
Hours per bale:							
1.97 - 2.75	7	1613	2.35	$2.61	$ .69	$ 1189.00	3.6
2.76 - 4.31	6	1763	3.16	3.49	–.19	–258.18	5.2

showed a very distinct advantage in net income for the group that used the smaller amount of labor per bale.

It is interesting to note that the big advantage gained by having a large volume can be at least partially offset by the inefficient use of labor. For instance, the six gins that had an average of 1,673 bales per gin but which used 3.2 hours of labor per bale had a net loss of $0.19 per bale. This loss cannot be attributed entirely to the inefficient use of labor but there seems to be little question but that this factor was one of the most important reasons why these large volume gins had a net loss on their ginning operations. The fact that these were much larger gins and yet had only a slightly larger volume than the other gins in this particular classification, no doubt accounts for some of the difference in the average income for the two groups.

It can be safely said, however, that for the gins in any volume group those that take care to see that labor is efficiently used so that a relatively small amount is applied to the ginning of each bale of cotton will have a better chance of returning a reasonable net income than those gins having inefficient and idle labor that results in a large average number of hours being applied to the process of ginning each bale.

Use of Capital

As has already been pointed out, the cotton ginning industry represents a fairly large capital investment in relation to the number of months in each year that the facilities are fully employed. That is, the average gin in this study had an investment of around $12,000 and was used at full capacity during about two months of the year. These facilities were often used at considerably less than capacity during an additional month to 6 weeks. The interest on the capital investment as well as certain obsolescense and depreciation costs go on all the time regardless of whether or not the facilities are in use. This makes it all the more important that the ginning facilities be used at full capacity during the period when they are in operation. In order to show the especial importance of this fact, the gins were sorted into five different groups according to the capital investment per bale of cotton ginned. (Table 9).

In general, it would be expected that those gins with the highest volume were the gins that made the most efficient use of this capital investment. However, this was not necessarily so because as is shown in table 9, there was not a constant relationship between the average investment per bale and the volume per gin. For instance, those gins that had an average investment of $11.34 per bale ginned an average of 1,318 bales; whereas the group of gins that had an average of $9.70 invested per bale ginned an average of only 966 bales. In general, however, there was a tendency for the average investment per bale to increase as the volume of ginning declined.

The average investment per gin bore no direct relationship to the investment per bale. However, the total cost of ginning a bale of cotton showed a definite tendency to increase as the investment per bale increased. The group of gins that had less than $9.00 invested per bale had an average per bale cost of $2.67. On the other hand, the group of gins that had over $15.00 invested per bale had an average cost of $5.91 for each bale of cotton ginned.

As would be expected, this same relationship was carried over into the net income. The net profit per bale for those gins making the most efficient use of their capital was $0.78 per bale; whereas those gins that used capital least efficiently lost an average of $2.59 per bale. On the basis of these figures, the gins that had an average investment of over $12.00 per bale stood a far greater chance of coming out with a loss at the end of the season than those with a smaller per bale investment.

There were nine gins that had less than $9.00 invested for each bale. The gins in this group ranged in volume from 690 bales to 2,581 bales. Their total capital value at the time of the study ranged from $4,500 to $19,800. Thus, it seems, that while the group having the lowest investment per bale usually has the largest volume per gin, it is possible for individual gins with relatively low volumes and low investments as well as gins with high volumes and high investments to be among the group of most efficient users of capital.

From the standpoint of doing a good job of ginning, the gin plant with the highest investment usually has the better ginning equipment and consequently performs a better job of ginning. However, from the standpoint of making profits in the ginning business, it is important to have a proper relationship between the volume ginned and the capital investment regardless of what that investment might be. Naturally the higher the investment the greater will be the volume necessary to show a profit on the operation of the gin plant. Every gin except one that had an investment of less than $9.00

Table 9. The relationship of the capital investment per bale of cotton ginned to cost, income, and other factors of gin operation, Mississippi, 1943.

Investment per bale	No. of gins	Bales per gin	Average investment per bale	Average investment per gin	Total cost per bale	Net income per bale	Hours of labor per bale
Less than $9.00	9	1520	$ 7.34	$11253.54	$2.67	$ .78	2.91
$9.00 - $11.00	7	966	9.70	9372.71	3.33	.09	3.36
$11.01 - $12.00	11	1318	11.34	14894.11	3.15	.24	2.50
$12.01 - $15.00	7	770	12.90	9812.97	3.93	–.40	4.18
Over $15.00	9	552	23.15	11800.74	5.91	–2.59	5.07

per bale showed a net profit on their ginning operation. On the other hand, every gin that had a capital investment of over $15.00 per bale showed a rather substantial net loss on their operations. This serves to emphasize again the fact that because of the relatively high investment cost and the comparatively short period of use, it is imperative for financial success that the capital investment be used to its fullest capacity.

Power Costs

Of the gins studied, 17 used Diesel type power. (Table 10). Of these 17 gins, 5 had 2 stands, 7 had 3 stands, and 5 had 4 stands. The bales ginned increased with the number of stands.

The average fuel used per bale decreased from 2.1 gallons per bale for 2-stand gins to 1.6 gallons per bale for 4-stand gins. The investment in the power plant for all Diesel type engines averaged $3,103 per gin. This, of course, was highest for the 4-stand gins and lowest for the 2-stand gins. The actual cost of fuel was relatively low, averaging $0.15 per bale for all Diesel type power. The total cost per bale decreased materially with the increase in the size of the gin. The 2- and 3-stand Diesel power gins, on the average, lost money whereas the 4-stand gins had an average net profit of $0.62 per bale. The investment per bale for the small Diesel power gins was very high. The average investment for the five 2-stand gins was $18.23 per bale. The average investment cost for this group of gins was $1.60 per bale. Both the investment and the investment cost per bale decreased progressively with the increase in the size of gins.

There were eight gins that used tractor fuel or fuel oil which had other types of fuel-burning engines. This group of gins used an average of 2.2 gallons of fuel per bale. The power plants of these gins were valued at an average of $1,581 or about one-half the average investment for power plants in the group of gins that used Diesel power. The average fuel cost for the other fuel burners was $0.20 per bale as compared to $0.15 per bale for the Diesel type engines. On the other hand, the investment and the investment cost per bale were somewhat less for the other types of fuel burning engines than for the Diesel type. The decrease in investment cost was more than enough to make up for the increase in fuel cost.

In addition, there were 9 gins that used gasoline burning engines. It so happened that all of these were 3-stand gins. They used an average of 2.8 gallons of gasoline per bale, the cost of which was $0.37. The power plants in these gins were valued at an average of $1,735, or only a little more than half as much as the investment in Diesel engines. When these nine 3-stand gasoline power gins are compared with the seven 3-stand Diesel power gins, it is seen that whereas the fuel cost is $0.21 per bale more for the gasoline type the investment cost per bale is $0.35 less for the gasoline type power than for the Diesel type power. It is apparent from this comparison that there is a possibility for the advantage in the cost of fuel in favor of Diesel power to be more than offset by the disadvantage of high investment costs.

From these results it is questionable whether a small 2- or 3-stand gin can secure enough volume under the conditions existing in the territory studied to pay for the relatively high investment in a Diesel engine and reap a profit on the ginning operation. If only fuel costs are considered, there is no question but that the Diesel type power has a very great advantage over the

Table 10. Relationship of the type of power to average cost, income, and other factors of gin operation, Mississippi, 1943.

Group	No. of gins	Bales ginned	Fuel per bale gal.	Capital value of power plant	Fuel cost per bale	Total cost per bale	Profit per bale	Investment per bale	Investment cost per bale
Diesel type power:									
2-stand gins	5	637	2.07	$2427.87	$0.18	$4.29	$ –0.95	$18.23	$1.60
3-stand gins	7	949	1.87	2900.06	.16	3.83	– .33	14.76	1.30
4-stand gins	5	1783	1.64	4062.86	.14	2.83	.62	9.08	.80
Average	17	1096	1.81	$3103.18	$ .15	$3.67	$ – .23	$14.11	$1.24
Other fuel oil type power:									
2- and 3-stand gins	5	563	3.04	$ 692.29	$ .33	$3.78	$ – .36	$11.80	$1.04
4 stands and over	3	1761	1.70	2470.10[1]	.14	3.72	– .36	12.73	1.12
Average	8	1012	2.16	$1581.19	$ .20	$3.76	$ – .36	$12.15	$1.07
Gasoline type power:									
3-stand gins	9	938	2.84	$1734.78	$ .37	$3.39	$ .02	$10.77	$ .95

[1] For double battery gins each unit was counted separately.

other types studied. However, in the long run the depreciation and interest costs have to be met. An investment cost that averages above $1.25 a bale is a very big initial handicap that most small gins using Diesel power have to overcome.

For the larger gins with fairly large volumes, the Diesel type power showed a distinct advantage in fuel cost, investment per bale, and investment costs per bale. When all gins in each group are compared, it is seen that the fuel costs per bale were lowest for the Diesel type engines and highest for the gasoline type engines with the other fuel types ranging in between. On the basis of investment costs, the arrangement was in exactly the reverse order. The decision as to which type of power to use should be based on a balance of these two factors.

As mentioned previously, the findings of this study indicate that the advantage in fuel costs for the Diesel type power for small gins is more than offset by the disadvantage of high investment costs. On the other hand, a fairly high fuel cost for gasoline type power and moderately high fuel costs for other oil burning engines for small gins, are more than offset by the relatively low investment cost. Such comparisons as it was possible to make further indicate that for a large gin with a fairly high volume, the Diesel type power has a distinct advantage in both fuel and investment costs.

There were only two gins in the group studied that had electric power. These two gins had an average volume of 1,732 bales and an average power cost of $0.51 per bale. The total power bill for these two gins averaged $897 for the season. This can be compared with an average of $168 for fuel costs for 17 Diesel engines, $208 for 8 other types of fuel burning engines, and $348 for 9 gasoline engines.

On the other hand, the investment cost was an average of $0.68 per bale for two gins using electric power. This investment cost is low compared to the other types of power but it does not appear to be low enough to completely offset the rather high power cost per bale. Four-stand gins using Diesel power with an average volume of 1,783 bales had an average fuel cost of $0.14 per bale and an average investment cost of $0.80 per bale. The two electric power gins of about the same size with a volume of 1,732 bales, had an average power cost of $0.51 per bale and an average investment cost of $0.68 per bale. On the basis of these comparisons, there was an advantage in fuel costs in favor of the Diesel type power of $0.37 per bale as compared to an advantage of only $0.12 per bale in investment cost for the electric power gins. The electric gins were not included in the table because of the small number, but it is probable that the comparisons given above account for the fact that so few gins in the territory studied are using electric power.

Of the other seven gins, two used natural gas, one used butane gas, one used steam, one used a combination of steam and fuel burning engine, and the other two used various combinations of fuel oil, gasoline, and kerosene. There was not enough in any of these groups to make any worth-while comparisons.

FACTORS THAT INFLUENCE COTTON QUALITY

Practices which producers follow in harvesting and handling their cotton and the manner in which it is ginned has a direct bearing on the grade of ginned lint. Color, amount and nature of foreign matter, and ginning preparations are the major factors of grade, and all contribute to spinning quality and manufacturing performance of cotton lint. In analyzing the quality of ginning service performed by the three classes of gins in this study, ginning preparation is the only factor of grade considered because it is the grade factor most subject to control by the ginner. Preparation[3] is a term used to describe the degree of smoothness or the relative nappiness or neppiness of ginned lint. Although the condition of seed cotton when ginned has an important effect on preparation, the manner in which it is ginned and the condition of ginning equipment frequently determine whether the preparation of a bale is smooth or rough.

Cotton usually shows more rough preparation during the early part of the season, or after rains, or when dews are especially heavy. This indicates that cotton is frequently harvested when too green or wet, and is not allowed to dry sufficiently before it is taken to the gin. Partly because of the unusually dry period preceding and for some time after the 1943 harvesting and ginning season began in Mississippi, the amount of roughly ginned cotton was very small. But the opposite condition prevailed at the beginning of the 1942 season when a relatively high percentage of cotton showed rough ginning. The percentage of roughly ginned cotton in Mississippi for the 1942 season was 7.9 percent as compared with 4.8 percent in 1943. It is likely that a large part of this difference in the percentage of rough preparation was brought about by the green and damp condition of cotton at the beginning of the 1942 season.

According to the Bureau of the Census, Mississippi produced 1,886,981 bales of cotton in 1942 and 1,781,926 bales in 1943 (figures for 1943 are preliminary). If the percentages for rough preparation, given in the preceding paragraph, are applied to total ginnings, the number of bales roughly ginned in Mississippi was 149,072 in 1942, and 85,532 in 1943. It is reasonable to assume that a loss of at least 3 dollars per bale was suffered by the farmer when he sold the bales roughly ginned. This would mean a loss to farmers in Mississippi of about $447,000 in 1942 and more than $255,000 in 1943, because of rough preparation.

Gins used as a basis for this study were selected in a relatively small area where cotton grown was largely of one variety and where relatively uniform weather and soil conditions and harvesting and handling methods prevailed, thus, holding constant so far as practicable, the influence of a number of factors that contribute to ginning preparation other than those in the ginning processes.

The gin operation practice that has the major influence on the preparation of the lint is the density of the seed roll employed in ginning the cotton. Seed roll density in turn is dependent upon the rate of feed of the cotton to the gin stands, the setting of the seed boards used in regulating the rate of discharge of the ginned seed from the seed roll box. Other factors include speed and condition of the gin saws and condition of other vital parts of the gin stands including ribs and brushes. The gins selected for the study were divided into three groups, as previously mentioned, and these operating practices were taken into consideration in stratifying the gins for a determination of the comparative effect of modern, average, and sub-standard gins on preparation as well as gin turnout (Table 11).

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[3] **The Classification of Cotton,** Bureau of Agricultural Economics, U. S. Department of Agriculture, Miscellaneous publication No. 310, 54 pp., illus. 1938.

A majority of the modern gins were operated according to the accepted standards for good ginning.[4] All gins in the group were operated with loose seed rolls and about two-thirds of them were operated with saw speeds of 600 to 750 revolutions per minute. Ginning equipment was adequate and in generally good condition. The average gins were usually operated with loose to medium dense seed rolls. Almost all of them were operated with saw speeds ranging from 400 to 599 revolutions per minute. The condition of saws and ribs was about equally divided between good and fair. Most of the sub-standard gins were operated with loose seed rolls and at speeds of 400 to 599 revolutions per minute. The saws and ribs were usually in fair to poor condition. Several of the gins in this group were operated at speeds below 400 revolutions per minute.

Effect of Ginning on Preparation

Samples of ginned lint from gins in each group were classified and the percentage of cotton that was ginned rough or ginned in such a manner as to cause a reduction of one or more grades was determined. The number of gins, by groups and the ranges of rough preparation, are given in table 12. All but one modern gin, and two average gins showed less than 4 percent rough cotton. A majority of sub-standard gins also had less than 4 percent roughly ginned cotton, but a little more than one-third of them had 4 to 10 percent rough preparation. The general tendency was for the percentage of

Table 11. Percentage distribution of gins according to some of the more important factors affecting ginning preparation, by groups, Mississippi, 1943.

Factors of gin operation	Group			All groups
	Modern	Average	Sub-standard	
	percent	percent	percent	percent
Density of seed roll:				
Loose	100	40	79	69
Medium	0	53	7	23
Tight	0	7	14	8
Total percent	100	100	100	100
Saw speed, r.p.m.:				
600 and above	67	0	0	16
400 to 599	33	93	79	73
399 and below	0	7	21	11
Total percent	100	100	100	100
Condition of saws:				
Good	78	47	26	45
Fair	22	47	37	38
Poor	0	6	37	17
Total percent	100	100	100	100
Condition of ribs:				
Good	60	53	31	46
Fair	40	47	31	39
Poor	0	0	38	15
Total percent	100	100	100	100

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[4] Bennett, Charles A., Baggette, T. L., Gerdes, F. L., **Modernizing Cotton Gins**, U. S. Department of Agriculture, Farmers Bulletin No. 1802, 52 pp., illus. 1939.

Table 12. Distribution of gins according to percent ranges of roughly ginned cotton, by groups, Mississippi, 1943.

Percentage of rough preparation	Group			Total gins
	Modern	Average	Sub-standard	
0 to 1.9	5	10	5	20
2.0 to 3.9	4	5	5	14
4.0 to 5.9	—	—	3	3
6.0 to 7.9	—	2	2	4
8.0 to 9.9	—	—	1	1
10.0 to 11.9	1	—	—	1
Total gins	10	17	16	43

rough preparation to increase as the condition of machinery and equipment approached the sub-standard classification. However, a few of the gins in each group had 100 percent smooth preparation.

The number of samples classed by ginning groups and the proportion of roughly ginned cotton is shown in table 13. Modern gins had a smaller proportion of roughly ginned samples than did either of the other groups and sub-standard gins had the highest proportion of roughly ginned samples. The average rough cotton for modern gins was 2.5 percent, and for average and sub-standard gins 2.8 and 3.5 percent, respectively. Since all factors involved in the ginning process were taken into account, table 13 indicates generally the effect of equipment and its condition on preparation.

Lint Turnout

A comparison of the ratio of lint to seed cotton for the three groups of gins is shown in table 14. Again, the modern gins had the best record of ginning when compared with the other groups. Lint turnout for the three groups were: modern, 38.0 percent; average, 37.6 percent; and sub-standard, 37.6 percent. This means that the modern gins produced an average of 5 pounds more lint per standard size load of 12 hundred pounds of seed cotton than sub-standard gins. This difference measured in terms of the average prices received for lint and seed by producers in Mississippi during the 1943 season amounts to approximately $1.00 per bale.

Table 13. Proportion of roughly ginned cotton by gin groups, Mississippi, 1943.

Group	Samples classed	Bales roughly ginned	Percentage of rough preparation
Modern	12,188	300	2.5
Average	8,860	246	2.8
Sub-standard	7,355	260	3.5
All	28,403	806	2.8

Table 14. Ratio of lint to seed cotton by ginning groups, Mississippi, 1943.

Group	Gross weight of sample[1] seed cotton	Net weight of lint cotton[2] in sample	Ratio of lint to seed cotton
Modern	1,687,180	641,711	38.0
Average	1,604,929	604,236	37.6
Sub-standard	1,397,333	525,186	37.6
All	4,689,442	1,771,133	37.8

[1] Includes weight of trash. Every 10th bale of cotton ginned throughout the season used as a sample.

[2] Less weight of bagging and ties.

Ginning laboratory tests, over a period of years, have shown that the ginning capacity may be increased almost 20 percent for both short and long staple cotton, and bale weights increased from 15 to 20 pounds with loose seed roll ginning and saw speeds increased to 600 revolutions per minute. Many gins in Mississippi have been over-hauled during the past few years in order to effect loose seed roll and relatively high speed ginning.

Density of Seed Roll

As shown in table 15, the percentages of rough cotton were uniformly low for all gins operating with loose seed rolls. The general tendency was for gins operated with loose rolls to turn out smoother samples than those with either medium or tight rolls. Taking all gins in the three groups into account, the proportions of rough cotton were: loose, 2.3 percent; medium, 3.8 percent; and tight, 4.2 percent. Tight seed roll density is usually caused by feeding seed cotton into the gin stands too fast. But other contributing factors are improper seed board setting and saws that are in poor condition because of dull or broken teeth.

Saw Speed

For the purpose of determining the influence of saw speed on ginning preparation, the three gin groups were divided into three saw speed ranges, 600 revolutions per minute and above, 400 to 599 revolutions per minute, and below 400 revolutions per minute. Performance of the various ginning groups according to indicated speeds is given in table 16.

When all gins included in the study are considered, those with saws operating at 600 revolutions per minute and above, had the lowest percentage (2.1) of rough preparation, and those with saws operating at less than 400 revolutions per minute had the highest precentage (5.2) of rough preparation. Usually saw speeds of 600 or above characterize the well equipped and

Table 15. Density of seed roll as related to ginning preparation of cotton, by gin groups, Mississippi, 1943.

Group	Density of seed roll					
	Loose		Medium		Tight	
	Samples classed	Percentage of rough preparation	Samples classed	Percentage of rough preparation	Samples classed	Percentage of rough preparation
Modern	12,188	2.5	—	—	—	—
Average	2,371	1.7	4,885	3.7	550	3.3
Sub-standard	4,273	2.2	547	4.6	1,822	4.4
All	18,832	2.3	5,432	3.8	2,372	4.2

Table 16. Saw speeds as related to ginning preparation by gin groups, Mississippi, 1943.

Group	Saw speed, r.p.m.					
	600 and above		400 to 599		Below 400	
	Samples classed	Percentage of rough preparation	Samples classed	Percentage of rough preparation	Samples classed	Percentage of rough preparation
Modern	6,965	2.1	3,491	2.8	—	—
Average	—	—	5,141	1.9	1,958	6.4
Sub-standard	—	—	5,910	3.7	1,003	3.0
All	6,965	2.1	14,542	2.9	2,961	5.2

properly operated modern gin, whereas saw speeds of below 400 revolutions per minute usually are found in the poorly operated and inadequately equipped sub-standard gin.[5]

Air Pressure

Control of air pressure on air blast gins is important in that too much pressure will not only increase power expense but will tend to produce roughly ginned cotton. The effects of air pressure on ginning preparation is indicated in table 17. Laboratory tests have shown that an air pressure of 13 to 14 inches measured on a water gauge, is the most efficient setting both from the standpoint of power efficiency and ginning preparation. The relationship of nozzle pressure to percentage of rough preparation, as given in table 17, follow closely the findings of the Stoneville laboratory.[6]

TRANSPORTATION OF SEED COTTON TO GINS

The distance farmers have to haul their cotton and the means of transportation at their disposal often influence the decision as to where they are going to get their cotton ginned. It may be that the producer would get a more efficient job of ginning by patronizing a different gin but in many instances the better gins are located considerable distance from the producers. In such cases, the gain made by getting a better job of ginning might be completely offset by the additional expense incurred by hauling the cotton longer distances.

The findings of this study indicate that the modern gins are performing the ginning service more efficiently and at less cost to the producer than are the gins in either of the other two groups. Just how much these additional advantages mean to a producer in the form of monetary returns per bale of cotton ginned has not been adequately determined. However, there is little question but that there is some difference in the value of cotton ginned at the modern gins and cotton ginned at the sub-standard gins.

In order to determine the present practices followed by producers in getting their cotton ginned, a sample of customers of each gin was recorded and later located on large outline maps of each county. The straight line distances from the farmers' home to the gin patronized were calculated for 19 of the gins for which cost information was obtained. A tabulation of these distances showed that cotton was hauled an average of 0.6 miles further to the modern gins than to the sub-standard gins. (Table 18). Slightly over 29 percent of

Table 17. Nozzle pressure of air-blast gins as related to ginning preparation, by groups, Mississippi, 1943.

Water gauge pressure in inches	Samples classed	Bales roughly ginned	Percentage of rough preparation
13 and below	8,610	162	1.9
14 and 15	5,650	152	2.7
16 and above	1,576	66	4.2
All	15,836	380	2.4

---

[5] Bennett, Charles A. and Gerdes, Francis L., **Effects of Feeds and Saw Speeds on Cotton Turn-out and Quality,** U. S. Department of Agriculture, Leaflet No. 151, 4 pp., illus. 1927.

[6] Johnson, Arvid J., Baggette, Thomas L., **Air-blast Gin Performance and Maintenance,** U. S. Department of Agriculture, Circular No. 510, 17 pp., illus. 1938.

the customers of modern gins hauled their cotton less than 3 miles. On the other hand, 56 and 53 percent, respectively, of the customers of average and sub-standard gins hauled their cotton less than 3 miles. This would indicate that the modern gins served a somewhat larger territory than did the gins included in either of the other two groups. It has already been pointed out in another section of this report that modern gins had a considerably larger volume than the sub-standard gins.

There are some other factors that influence the farmers' choice of the gin that are apparently about as important as the type of ginning machinery available. When the gins were grouped according to whether they were located in a town or the country, it was shown that cotton was hauled considerably longer distances to the town than to the country gin. (Table 19). This was true irrespective of the type of ginning machinery available in the towns as compared to that available in the country. Cotton was hauled an average of 5.3 miles to the town gins and only 2.7 miles to the gins located in the country. Of the cotton going to the country gins, 97.5 percent of it was hauled less than 5 miles, whereas of the cotton going to town gins only 56 percent was hauled less than 5 miles.

In the counties studied, the county seat is usually the main trading center for the entire county. Many farmers have to go to these trading centers for other purposes and consequently often haul cotton by several gins on their way to town. This fact is clearly shown by the information given in figure 2. This is a map showing the location of a sample of customers of 10 gins in Winston County. The three gins located in Louisville, the county seat, ginned cotton for farmers from almost every section of the county. The one exception was another small trading center in the southern part of the county that served a fairly exclusive territory. A number of farmers hauled their cotton from 15 to 20 miles right by two or three other cotton gins to carry it to the gins located in the county seat.

The information obtained indicates that somewhat the same situation existed in the other counties studied. Because of this tendency for farmers

Table 18. Comparison of the distances farmers haul seed cotton to gins, by groups, Mississippi, 1943.[1]

Group	Number of gins	Average distance miles	Percentage of farmers hauling cotton: Less than 3 miles	3.00-4.99 miles	5.00-6.99 miles	7.00-9.99 miles	10 miles and over
Modern gins	4	3.9	29.2	45.7	17.4	6.0	1.7
Average gins	6	3.8	55.8	22.0	6.5	7.1	8.6
Sub-standard gins	9	3.3	53.3	31.1	8.2	4.2	3.2
Average	19	3.6	49.0	31.3	9.6	5.5	4.6

[1] Straight line distances from the farm to the gin.

Table 19. Comparison of the distances farmers haul cotton to gins, by location, Mississippi, 1943.

Location	Number of gins	Average distance miles	Percentage of farmers hauling cotton: Less than 3 miles	3.00-4.99 miles	5.00-6.99 miles	7.00-9.99 miles	10 miles and over
Town gins	8	5.3	25.0	31.0	21.0	12.0	11.0
Country gins	11	2.7	66.8	30.7	1.6	.9	—
Average	19	3.6	49.0	31.3	9.6	5.5	4.6

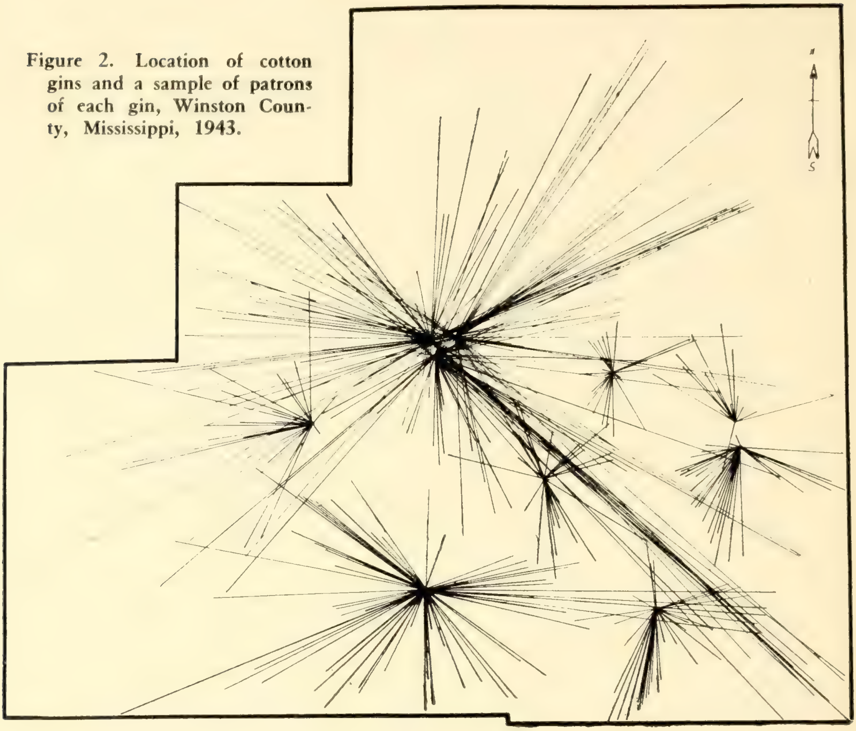

Figure 2. Location of cotton gins and a sample of patrons of each gin, Winston County, Mississippi, 1943.

to carry their cotton to the main trading centers and the fact that almost all farmers want their cotton put in the warehouse as soon as possible after it is ginned, practically all the country gins have been forced to transport the cotton that they do gin to the warehouses in the trading centers free of charge. That is, if a farmer is going to have to carry his bale of cotton to the warehouse anyway he would rather not be bothered with having to stop on the way and get it ginned and then take the ginned bale on to the warehouse. Consequently, in cases where ginners do not perform this extra service the natural tendency is for the producer to carry his seed cotton to the gins located near the warehouses. The compresses and warehouses are almost always located in the larger trading centers.

Another fact that influenced the farmers' decision as to which gin to patronize was the means of transportation at his disposal. Of the cotton ginned at modern gins slightly over 63 percent was hauled to the gin in the farmers' wagons. On the other hand, about 68 percent of the cotton ginned at sub-standard gins was hauled in wagons. (Table 20). Only a slightly smaller proportion of cotton going to sub-standard gins was hauled in farmers' own trucks or trailers than that going to modern gins. The ginners themselves hauled a little more cotton to sub-standard gins than to modern gins. However, for commercial trucks this situation was reversed. The amount being hauled by the ginners or by commercial trucks constitutes a

Table 20. **Means of transporting seed cotton to gins, by groups, Mississippi, 1943.**

Group	Cotton hauled by			
	Farmers'			
	Wagons	Trucks or trailers	Ginners' trucks	Commercial trucks
	percent	percent	percent	percent
Modern gins	63.3	26.0	4.0	6.7
Average gins	64.0	27.7	3.7	4.6
Sub-standard gins	67.9	23.7	5.3	3.1
Average	65.5	25.6	4.4	4.5

very small proportion of the total amount of cotton ginned. The average for all gins was about 4.5 percent for both ginners and commercial truckers. For all gins combined, 65.5 percent of the cotton was hauled in the farmers' wagons and 25.6 percent in the framers' trucks or trailers.

The gins located in towns had a much smaller proportion of wagon customers than the gins located in the country. (Table 21). Slightly over 45 percent of the cotton going to town gins was hauled in wagons as compared with over 76 percent of the cotton going to the country gins. On the other hand, a much larger proportion of the farmers having trucks and trailers carried their cotton to the town gins. This indicates that a rather large proportion of the farmers who depend on wagons to haul their cotton to the gin, patronize the gin closest home and that those who have trucks and trailers usually haul their cotton longer distances and often by two or three gins before they reach the gin of their choice. Here again the indication is that means of transportation available to the producer is a very important factor in determining the gin that he is going to patronize rather than the particular type of ginning machinery and equipment available at the various gins.

The farmers who have trucks and trailers and who live on fairly good roads in a majority of cases, take their cotton to the gins in the main trading centers. It was observed in several cases that they would often haul their cotton by a gin which was classified as modern for the purpose of this study, and carry it to an average or sub-standard gin in the local trading center. On the other hand, the farmers who depend on wagon transportation in many cases took their cotton to the near-by gins regardless of the type of equipment available at these gins.

Table 21. **Means of transporting seed cotton from farms to gins, by location of the gins, Mississippi, 1943.**

Location	Cotton hauled by			
	Farmers'			
	Wagons	Trucks or trailers	Ginners' trucks	Commercial trucks
	percent	percent	percent	percent
Town gins	45.3	41.5	3.7	9.4
Country gins	76.3	17.1	4.8	1.7
Average	65.5	25.6	4.4	4.5

SUMMARY

In 1906 there were 3,780 active cotton gins in Mississippi. This number declined constantly until in 1943 there were 1,227 active gins in the State.

The ginning industry in Mississippi represents a total investment of around $20,000,000. The farmers of the State pay from $7,000,000 to $8,000,000 a year, depending on the size of the crop, for the ginning services, bagging and ties.

The grade of cotton produced in the State has been declining for about 15 years. During the 3-year period, 1928 to 1930, 55 percent of the cotton produced graded above Middling, whereas during the period 1939 to 1941 only 19 percent of the cotton produced was in these higher grades.

This study was made in a small area, embracing four counties in central Mississippi. Varieties of cotton and growing conditions were fairly uniform throughout the area. A large proportion of the gins were in one-variety communities and sent samples to the United States Department of Agriculture classing office at Jackson, Mississippi.

After a careful appraisal of the machinery and equipment available at each gin the gins were divided into three groups: (1) modern gins, or those equipped to do an efficient job of ginning; (2) average gins, or those equipped to do a fair job of ginning; and (3) sub-standard gins, or those equipped to do the least efficient job of ginning. Detailed cost data were obtained from 43 gins at the close of the 1943 ginning season. The grades of all cotton classed from these and other gins in the territory were obtained from the official grade sheets of the classing office.

Some characteristics of the modern gins as compared to sub-standard gins were: larger volume, larger size of gin, larger investment, newer equipment, less invested per bale of cotton ginned, smaller charge per hundredweight of seed cotton, higher total expenses, also higher gross income and net profit, lower cost per bale, smaller quantities of labor and fuel applied to each bale ginned, looser seed roll, higher speed of saws, better condition of saws and ribs, less rough preparation, and more cotton lint obtained per standard load of seed cotton.

All the gins combined paid an average salary for management of $378, took care of an average depreciation charge of $562, paid 4 percent or $470 interest on the capital invested, and in addition, returned a net profit of $57 on the ginning operation, $972 net return on cottonseed handling, and $267 profit on bagging and ties, or a net profit on all operations of $1,296.

The total cost for all gins for ginning a bale of cotton including management costs, interest, and depreciation was $3.35. The average gin tolls amounted to $3.41 per bale, leaving an average net profit over and above all costs of $0.06 per bale. When the net income on cottonseed and bagging and ties was included there was an average net profit of $1.23 per bale.

It took an average of 3.1 hours of labor, including management labor, to gin a bale of cotton. Fuel burning engines used an average of 1.9 gallons of fuel oil per bale, and gasoline engines used an average of 2.8 gallons of gasoline per bale.

For all sizes of gins the ones that had the larger volumes ginned cotton cheaper per bale and made the greatest profit per bale and per gin. Likewise, for gins with uniform volumes, the ones that used the least amount of labor per bale ginned cotton the cheapest and made the most money.

Gins that had a capital investment of over $12.00 per bale found it difficult to make a profit. The gins with less than $12.00 invested per bale made a progressively larger net profit per bale as the per bale investment decreased.

Small gins with Diesel type power as a group lost money on their ginning operations. The relatively low fuel cost was more than offset by the high investment cost. Diesel type power showed a distinct advantage over other types of power for large gins with a fairly high volume. However, for small gins with average volumes for the area other fuel burning and gasoline engines had an advantage over the other types.

The gins included in this study had an average of 2.8 percent rough preparation while the average for the State was 4.8 percent. Gins with loose seed rolls had an average of 2.3 rough preparation while those with tight rolls had 4.2 percent rough cotton. Gins operating with saw speeds of 600 and over revolutions per minute had 2.1 percent rough cotton while those operated at speeds below 400 revolutions per minute had an average of 5.2 percent rough preparation.

Air-blast gins with a nozzle pressure of 13 inches and below had 1.9 percent rough cotton while those with a pressure of 16 inches and above had an average of 4.2 percent rough cotton.

Farmers were located an average of 3.6 miles in a straight line from the gins they patronized. Almost 80 percent of the farmers were located less than 5 miles from the gins. Cotton was hauled considerably longer distances to gins in the main trading center than to country gins. A much higher proportion of the cotton going to country gins was hauled in wagons than was the case for cotton going to town gins. The distance to the gin and the means of transportation available are important factors that determine a farmer's choice of a gin.

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Organization and Operation of Farms

in

Black Prairie Area, Mississippi

By

W. G. O'LEARY

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AGRICULTURAL EXPERIMENT STATION
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Frank J. Welch, Head
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ORGANIZATION AND OPERATION OF FARMS IN THE BLACK PRAIRIE AREA OF MISSISSIPPI

By W. G. O'LEARY, Assistant Agricultural Economist

The Northeast Prairie, often called the Black Prairie, is one of the distinctive soil and type-of-farming areas in Mississippi. The agriculture of the area is, in general, characterized by diversification, with major emphasis on cotton, dairying, and livestock production. The Black Prairie Soils Area forms a partial crescent varying from 10 to 30 miles in width and extends from central Alabama into the following seven counties in Northeast Mississippi: Noxubee, Lowndes, Oktibbeha, Clay, Monroe, Chickasaw, and Lee. The extent of the typical Prairie Soils varies from county to county. None of the counties, however, are entirely within the black land area. See figure 1.

The geologic material is of the Selma Chalk formation, which is made up of soft limestone from 200 to 800 feet deep. This type of soil material under a grass vegetation gave rise to Prairie-like soils. Some soils developed under trees and are not Prairie-like soils. The chief calcareous soils are Houston and Sumpter clay on uplands, Trinity clay in bottoms, and Bell clay on the terraces. Catalpa is an excellent bottom soil which is an alluvial deposit made up from the combined washings of lime uplands and sandy uplands adjoining the Selma Chalk formation. In proximity to the upland calcareous soils are the Oktibbeha and the Vaiden soils, which are brown or yellow to reddish-brown soils low in lime. Oktibbeha soils are often called "post oak" or "red prairie" soils by the local people. Limestone underlies all the soils at various depths, and the texture of most soils is clay.

When Mississippi was first settled, the dark Prairie section was one of the most productive areas in the entire State. Large areas of relatively deep, easily cultivated Houston and similar soils were at the disposal of the early farmer, and the Prairie Belt was far different from what it is today. Large tracts of land like this were favorable to the large plantation type of farm operation. The nature of the soils, together with the system of management, stimulated sheet erosion in the early stages of Prairie farming and this hazard continued unnoticed (because of no gullies) for many years. Today the soil pattern is vastly modified and instead of finding dark, relatively deep fertile soils, we find limestone exposed on many upland fields. The productivity decreased as the soil washed away; and finally, the Prairie section of Mississippi, which was once the "garden spot" of the State, became a serious problem area. The changed soil conditions demanded a shift in agricultural practices, which is expressed in the over-all picture of the type of farming common in the Prairie section today.

Besides local problems, the Prairie has the problems common to all cotton areas. Without attempting to analyze the cotton outlook situation, it is assumed that there are economic and physical factors that will seriously hinder further increase in cotton acreage. In fact, the present level of cotton production will have to be accompanied by increased production, efficiency, and reduced costs. As far back as 1880, there appears to have been some recognition given to the potential possibility of livestock development in the Black Prairie Area. Due, however, to the difficulties of establishing steady favorable marketing outlets and other factors there was little livestock and development within the area until after the second decade of the 20th Century.

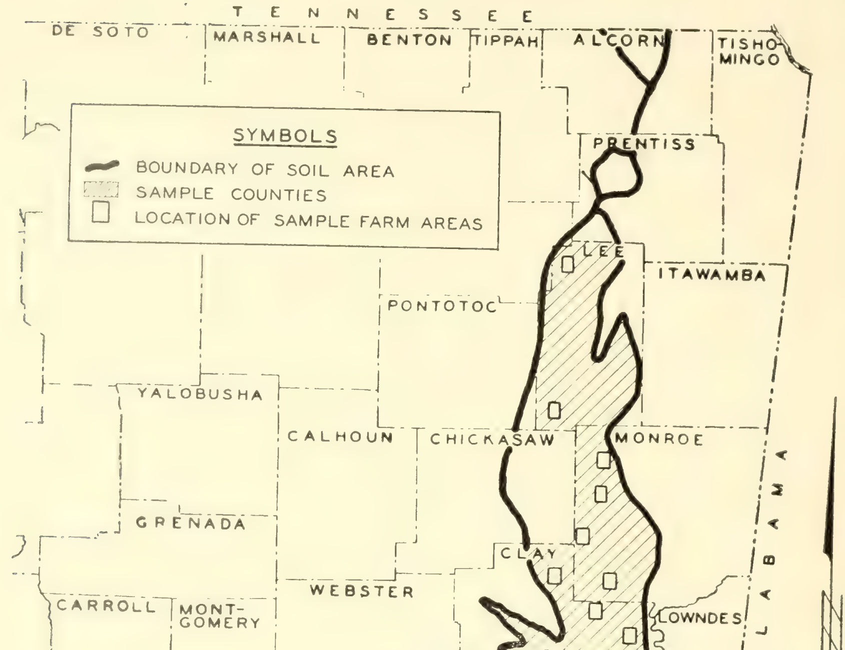

Figure 1. Location within the State of the Northeast Prairie Soil Area, the sample counties studied, and approximate location of block sample areas in which each farm was studied.

By 1915, the boll weevil created a crisis in cotton growing. By 1926, Prairie counties were becoming free of the cattle tick. From the latter date, there was rapid establishment of milk-processing plants and milk and cream routes. At present, the problem is that of supplying the processing plants with a steady, adequate volume of milk for economical year-round operations. These milk processing plants together with a number of livestock auctions which have been developed within the last 10 years have given sharp impetus to dairy and livestock development within the area.

Tables 1 and 2 show that in seven part-Prairie counties, cotton acreage was reduced an average of 31.9 percent from the period 1932-33 as compared with the average for the period 1934-1942. On the other hand, during the same period, there was a 20.6 percent increase in total cotton production for the area. In the earlier period, 4 acres were required to produce a bale of cotton; in the latter period, 2.2 acres; and in 1942, only 1.6 acres were required.

As a result of the operation of agricultural programs and an increase in mechanized farm equipment, 148,423 acres of cotton land was diverted to other usage between 1932 and 1942. With the number of workstock decreasing as a result of mechanized operation, and hence less need for feed, the matter of utilization of displaced cotton acreage became a serious problem. Tables 3 and 4 indicate the adjusted land-use pattern.

Table 1. Average cotton acreage and production in seven part-Prairie counties and percentage changes, 1932-33 and 1934-42

County	Average cotton acreage		Percent change	Average cotton production		Percent change
	1932-33	1934-42		1932-33	1934-42	
	Acres	Acres		Bales[1]	Bales[1]	
Clay	27,900	19,728	—29.3	6,072	7,492	23.4
Lee	64,750	42,644	—34.1	13,540	22,705	14.7
Monroe	66,550	45,898	—31.0	15,971	21,651	35.6
Noxubee	52,600	35,474	—32.6	12,153	14,468	19.0
Lowndes	44,150	30,080	—32.9	11,293	12,257	8.5
Oktibbeha	20,300	14,214	—30.0	4,791	5,023	4.8
Chickasaw	37,000	25,294	—31.6	8,591	11,265	31.1
Seven counties	313,250	213,332	—31.9	78,670	94,861	20.6

[1] A bale is here calculated as 500 pounds gross weight or 478 pounds of lint.

Source: Records and estimates of Agricultural Adjustment Agency.

Table 2. Average cotton acres to bale[1] in specified periods; and acres diverted from cotton, acres in cotton, and cotton production, seven part-Prairie counties, 1942

County	Cotton acres to bale			Acres diverted from cototn 1942	Acres in cotton 1942	Cotton production 1942, bales
	1932-33	1934-42	1942			
Clay	4.6	2.6	1.8	14,132	16,221	9,014
Lee	4.8	1.9	1.3	27,594	39,535	30,615
Monroe	4.2	2.1	1.6	28,080	41,736	26,517
Noxubee	4.3	2.5	1.7	25,417	29,362	16,910
Lowndes	3.9	2.5	2.0	22,991	23,395	11,837
Oktibbeha	4.2	2.8	2.5	12,341	10,171	4,017
Chickasaw	4.3	2.2	1.4	17,868	22,490	15,856
Seven counties	4.0	2.2	1.6	148,423	182,910	114,766

[1] A bale is here calculated as 500 pounds gross.

Source: Records and estimates of Agricultural Adjustment Agency.

Table 3. Acreages of plowable pasture and hay, three part-Prairie counties[1] and State, with percentage increases,[2] 1930, 1940

Area	Plowable pasture			Hay		
	1930 acres	1940 acres	Percentage increase	1930 acres	1940 acres	Percentage increase
3 Prairie counties	107,002	179,480	67.7	28,188	66,030	134.2
State	1,495,294	2,702,190	80.7	316,034	821,973	160.1

[1] Clay, Lee, Monroe.

[2] In the three counties in 1939, plowable pasture was 32.55 percent of the sum of all cropland and plowable pasture, and in the State only 25.2 percent.

Source: United States Census of Agriculture.

Table 4. Percentage distribution of all land in farms, and of cropland, according to use, three part-Prairie counties[1] and the State, 1939

All land in farms			Cropland		
Item	3 counties percent	State percent	Item	3 counties percent	State percent
Cropland harvested	34.0	36.3	Corn	39.5	42.5
Crop failure	7.3	2.2	Cotton	33.7	35.2
Cropland idle or fallow	3.3	3.3	Hay	23.3	11.8
Plowable pasture	21.5	14.1	Other crops	3.5	10.5
Woodland	22.0	31.7			
All other land	11.9	12.4			
Total	100.0	100.0	Total	100.0	100.0

[1] Clay, Lee, Monroe.

Source: United States Census of Agriculture.

During this period the percentage of total farm income from livestock and livestock products was increasing, as indicated by table 5. Furthermore, this part of the total farm income proved to be rather stable during the poor crop years of 1939 and 1940.

In addition to the usual inertia associated with change, there are a number of factors present that tend to discourage shifting from cotton products to dairying and livestock operation. In order to succeed with livestock the cotton farmer has to learn about animal diseases, culling, testing, breeding, balanced feeding, marketing, and buying. He must learn how to develop

Table 5. Distribution of cash farm income from marketings, by source, with percentages, three part-Prairie counties,[1] 1939

Item	Clay dollars	Lee dollars	Monroe dollars
All farm products sold	585,182	1,148,862	1,404,124
Livestock and livestock products sold	347,877	486,794	350,022
Percentage of all sales	59.4	42.4	24.9
Livestock sold	116,073	89,872	139,257
Percentage of livestock and livestock products sales	33.4	18.5	39.8
Crops sold or traded	233,387	659,242	1,027,457
Percentage of all farm sales	39.9	57.4	73.2
Cotton and cottonseed sold or traded	168,191	576,746	812,544
Percentage of all sales	28.7	50.2	57.9

[1] Since the data are for entire counties (Clay, Lee, and Monroe), it is probable that Prairie farmers would show higher proportions of income from livestock and livestock products.

Source: United States Census of Agriculture.

pastures on varied soils, and on as nearly a year-round basis as possible. In addition, the diversification of farms usually requires an increased amount of working capital over that which is required for cotton farms.

Changes in the economy of the Prairie are reflected in changes in the numbers and characteristics of the population. From 1900 to 1940 there was a decline of 10.6 percent in the negro population of seven part-Prairie counties, an increase of 67.5 percent in the white population, and an increase of 15.8 percent in the total population. See table 6. In 1900, negroes were 66.4 percent of the total; in 1940, only 51.3 percent. The negro population declined in all counties except Lee. The total population declined 2.7 percent in Clay, and 16.8 percent in Noxubee, but increased in all other counties, the increase being 76.9 percent in Lee and about 21 percent in Lowndes and Monroe.

In the same period there was a marked increase in the number of inhabitants of towns and cities of over 2,500 population. In 1940 there were 40,857 persons living in towns and cities in the Prairie counties. The proportion of the population living in towns and cities is about the same in the Prairie counties as in the State. Also, in 1940, there were 26,767 persons classed as rural-nonfarm, so that the rural-farm population was 132,384. It is apparent that the small towns and the cities are absorbing the increase in population, except for large numbers who migrate and that a better balance between agriculture and the industries of towns is developing. Prairie counties are in the TVA area and have had the use of electric power in the development of their resources.

Objectives of the Study

The objectives of the study were as follows: (1) to describe the present agriculture of the area in terms of land use, cropland and livestock organizations, size of farms, type of farms, tenure of operators, and management practices related to the operation of farms; (2) to make a cost and income analysis of different sizes and types of farms; (3) to make time studies of standard farm operations; (4) to determine some of the major agricultural problems of the area; (5) to suggest adjustments which will help to solve these problems; and (7) to estimate the effect of suggested adjustments on the agriculture in the area.

Method of Study

For the field study, Clay, Lee, and Monroe Counties were selected as a sample to represent the Prairie Area.

Two main sources of information were used: the operators of sample farms in the area and the records of the AAA offices of the three sample

Table 6. Distribution of population by race, with percentage changes, seven part-Prairie counties[1], 1900-1940

Item	1900	1910	1920	1930	1940	Percentage change 1900-1940
Total population	172,751	186,003	170,147	184,886	200,008	15.8
Whites	58,123	70,576	76,703	87,256	97,352	67.5
Negroes	114,628	115,427	93,444	97,630	102,656	—10.6

[1] Chickasaw, Clay, Lee, Lowndes, Monroe, Noxubee, and Oktibbeha.

Source: United States Census of Population.

counties. From the farm operators there was obtained full information regarding farm acreage, values, mortgages, production, equipment, expenses, incomes, fertilizer uses, crop and livestock organization, and related data. The survey method was used to obtain the data, and sufficient information was obtained from each farmer to calculate the 1942 net farm income.

The farms to be surveyed were selected at random by using a block method of spotting. Small areas were outlined on a map for each of the three counties and a random sample of these areas was selected for study. By use of aerial photographs, the names of the operators of all farm units in each block were ascertained. Each operator was contacted when possible, and a record of his 1942 farming operations obtained. A total of 108 complete farm records was obtained, covering practically all farms in 9 block sample areas as indicated in figure 1.

In addition to the complete farm records, practice sheets were obtained on all principal crop and livestock enterprises in the area. These practice sheets were, in most cases, obtained from the operators of the sample farms, but to obtain the desired number on some enterprises, it was necessary to interview nearby farmers. The practice sheets numbered 180. The information obtained from farmers was supplemented by information from the County AAA offices as to 5-year average cotton yields, AAA payments, and acreage measurements. In addition, information was obtained on approximately a 12 percent sample of AAA farm units in the Prairie Area of the three counties. This information was relative to land, sizes of farms, tenure of operators, and livestock numbers.

The farm data were collected for the 1942 crop year, and represent the crop and livestock organizations and the management practices prevailing at that time. The income and cost calculations have, however, been adjusted to the average of the 5-year period, 1939-43. See Appendix tables 2-5. The price relationships and farm organization and management practices as adjusted will, it is thought, more nearly represent conditions likely to prevail in the post-war period than would the 1942 data unadjusted. They do not represent conditions of considerable inflation or depression.

Definition of Terms

Operating unit. Refers to the management unit; it is all the land included in one AAA contract and is generally a continuous tract. The operating unit and the farm are used interchangeably in this report.

Operator. The person who is responsible for management of an operating unit; he may be an owner, a farm manager, or a tenant who exercises chief control over his farming operations. The term does not refer to sharecroppers or other tenants who are closely supervised in their farming operations.

Gross farm income. The total returns to a family from the sale of farm products, AAA payments, increases in livestock inventories, and the value of home-grown products used by the family. No attempt was made to place a rental value on the home.

Gross cash farm income. Same as gross farm income except that it does not include the value of home-grown products used by the family. Changes in livestock inventories are treated as cash items.

Cash farm expenses. Cash expenditures of the farm business and certain items treated as cash, namely livestock purchases, decreases in livestock inventories, and allowances for normal repairs on machinery and buildings.

Non-cash farm expenses. Depreciation charges on buildings, workstock, and machinery.

Net cash farm income. Gross cash income less cash farm expenses.

Net farm income. Gross farm income less total cash and non-cash farm expenses.

Normalized farm income. Income calculated from price figures adjusted to the average of price levels prevailing in the area during the 5-year period, 1939-43, and to average cotton production in the same period.

Farm investment. The aggregate value of real estate, farm machinery, workstock, and livestock on a farm.

Interest on investment. The amount calculated by applying an interest rate of 5 percent to the farm investment.

Family labor earnings. The returns to the family for labor and management after all charges against farm income have been deducted. It is calculated by deducting interest on investment from net farm income.

Prairie Agriculture In 1942

Size of Farms

The Northeast Prairie was, before the Civil War and long afterwards, noted for its great cotton plantations. The expansion of the Delta as a cotton plantation area has left the Prairie in a secondary rank in this respect. However, the system of farming with tenants is still predominate in the Prairie. The 12 percent sample showed that 5 percent of the AAA operators had a total of 48.2 percent of the cropland operated in the Prairie Area. The same 5 percent of the AAA operators each had over 500 acres of cropland, with an average of 1127 acres per farm in the group and in addition an average of 321 acres of open pasture. See table 7.

Of 108 farms on which complete schedules were obtained in this study, 92 classified in one or another of the principal types of farming in the area. Of these 92 farms, 41 were one-family farms operating a total of 2,847 acres of land in farms; 23 were two-family farms operating a total of 2,872 acres; and 28 were farms of three-or-more families and operated 13,901 acres.

Although the larger area was farmed by large operators, the greater number of operators had small farms. Seventeen percent of the operators had 15 acres of cropland or less; 49 percent, 40 acres or less; 77 percent, 100 acres or less, and 88 percent, 200 acres or less. See table 7. Forty-eight percent of the farms in the Prairie area of the sample counties were operated as one-family units, 16 percent as two-family units, and 36 percent as units of three-or-more families (in this bulletin called "multiple family units"). See table 8.

Tenure and Leases

Approximately one-fifth of the farms in the area were operated by tenants who signed contracts with the AAA.[1] Although comparable data are not available, it is thought that the proportion of operators who are tenants is perhaps as low in this area as in any other section of the State. In the south

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[1] "Operator" is used in the sense as employed by the Agricultural Adjustment Agency and does not include croppers or renters who do not have AAA contracts listed in their names.

Table 7. Size of farms, percentage of cropland planted to cotton, and averages per farm cropland, open pasture, and cotton acreage, by range in cropland acres, Northeast Prairie Area, 1942

Item	Farm size, range by acres of cropland										
	0-15	16-20	21-40	41-60	61-100	101-200	201-300	301-400	401-500	Over 500	Total
Percentage distribution of farms by acres of cropland	17	8	24	15	13	11	3	3	1	5	100
Percentage distribution of farms accumulated from zero to upper limit of range in cropland acres		25	49	64	77	88	91	94	95		100
Percentage of cropland planted to cotton by size of farms	19	30	28	27	28	27	20	21	26	27	26
Average per farm in size group:											
Cropland (acres)	9	17	29	50	78	139	236	347	499	1127	117
Open pasture (acres)	7	16	23	29	41	93	182	141	308	321	48
Cotton (acres)	2	5	8	13	22	37	48	73	117	307	31

Based on 12 percent of AAA worksheets in the Prairie Area of the three sample counties.

Table 8. Distribution of farms by size of operating unit, Northeast Prairie, 1942

County	Percentage of farms by size of operating unit			
	One-family	Two-family	Multiple-family	All farms
Clay	50	15	35	100
Lee	43	19	38	100
Monroe	54	12	34	100
Three counties	48	16	36	100

Source: 12 percent sample of AAA farm worksheets in Prairie Area of the three sample counties.

Table 9. Tenure of operators by size of farm, Northeast Prairie, 1942

Size of farm	Tenure of operators		
	Owner	Share tenant	Cash tenant
	Percent	Percent	Percent
One-family	76	18	6
Two-family	80	20	0
Three-or-more-family	92	3	5
All farms	81	14	5

Source: 12 percent sample of AAA farm worksheets in Clay, Lee, and Monroe.

Table 10. Rental contracts: percentage distribution by form and duration, tenant operators, Northeast Prairie, 1942

Form of agreement		Duration		
Oral	Written	1 year	5 years	Indefinite
92.7	7.3	78.2	1.8	20.0

Source: Sample of 108 Prairie farms.

half of the Brown Loam Area where comparable data are available, the proportion of operators who are tenants is approximately one-third.[2] The proportion of tenant-operated farms was highest in the smaller size groups. Share and cash tenants operated 24 percent of one-family size farms, 20 percent of two-family size farms, and 8 percent of multiple-family units. See table 9.

The most common method of renting land in the Prairie is the share system. One-fourth of the cotton and one-third of the corn is the usual land rent. In some instances where the acreage of volunteer Johnson grass is large on a rented farm, a share of the hay is also paid to the landlord, though custom has not yet established a definite system of sharing in this crop. In the sample of farms studied in 1942, cash rent was paid by only about one-third as many tenants as used the share system. Often, no rent was paid for the use of pastures. As in other sections of the State, rental agreements in the Prairie are generally oral and for one year's duration. Ninety-three percent of the rent contracts were oral, and 78 percent ran for only one year. The 20 percent of the contracts listed as being indefinite are for the most part oral and consequently from a legal standpoint are for one year. See table 10.

It has been pointed out many times that an unstable system of land tenure is harmful to the welfare of the people as well as to the natural resources available to agriculture. Observation and recorded data alike reveal that tenants who move nearly every year do not follow the farming practices that produce the highest returns or that help to conserve natural resources. No doubt their poor farming methods are, in many instances, the reason why they have to move, yet it is next to impossible for farmers to maintain livestock of any kind in substantial numbers or in good condition unless they can remain at one place for a number of years. Likewise, one cannot expect a tenant to make much contribution toward improving a farm if he is expecting to move at the end of the year. In line with this thought, there seems to be room for study of methods of stabilizing and improving the tenure system of operators in this area as well as other parts of the State. One adjustment that might be worthy of study is a system of sharing the proceeds from livestock between landlords and tenants. No case of livestock sharing was found in this area, but the system is said to function rather well in some states.

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[2] See Mississippi Agricultural Experiment Station Bulletin 384, **Organization and Operation of Farms in the Brown Loam Area**, by W. G. O'Leary.

Land Use and Farm Organization

The land in farms in the Prairie is of such physical condition that a high proportion is utilized. Of the sample farms studied in 1942, almost one-half of the farm land was classified by the AAA as cropland and an additional one-third was classified as open pasture. About 13 percent of the farm land was woodland, most of which was pastured. Only 4.1 percent was classified as "other farm land," which includes farmsteads, roads, ditches, and waste. The proportion of the land in different uses varied somewhat by size of farm, the smaller farms having a higher proportion in cropland and less in pasture, and the larger farms less in cropland and more in pasture. See table 11.

Of the cropland, 27.7 percent was in cotton in 1942, and slightly less, or 27.4 percent, was in corn. Hay crops accounted for 33.9 percent of the cropland, but the proportion in silage crops was only 1.3 percent. Hay crops, oats, silage, and pasture acreages were proportionately higher on the farms of smaller size. See table 12 for a breakdown of cropland according to use.

Milk Cows on Farms

Dairying is one of the most important enterprises on farms in the Prairie. Its important position is not so much a result of large scale dairy farms as it is a result of many small farmers producing milk for processing purposes. Fifty-nine percent of farms of all sizes have between 2 and 8 milk cows, 11 percent have 1 cow or none, and most of the remaining farms have between 8 and 15. See table 13.

Table 11. Percentage distribution of total land in farms by major uses, and by size of farms, Northeast Prairie Area, 1942

Item	One-family size	Two-family size	·Multiple-family size	All farms
	Percent	Percent	Percent	Percent
Total farm land	100.0	100.0	100.0	100.0
Cropland	64.3	50.8	48.0	49.3
Open pasture	15.4	26.8	36.3	33.6
Woods pasture	11.3	13.5	7.3	8.6
Woods not pastured	2.3	3.0	4.9	4.4
Other farm land	6.7	5.9	3.5	4.1

Source: AAA plan sheets for the 108 sample farms.

Table 12. Cropland organization: over-all distribution of cropland by use and by size of farms, Northeast Prairie Area, 1942

Crop	Size of farm			
	One-family	Two-family	Multiple-family	All farms
	Percent	Percent	Percent	Percent
Cotton	28.3	26.3	27.8	27.7
Corn	32.4	27.2	26.2	27.4
Oats (grain)	1.7	1.0	7.5	5.6
Cowpeas (seed)	2.6	2.8	.2	1.0
Soybeans (seed)	.7	.4	.7	.7
All hay	26.0	35.1	35.6	33.9
Sorghum (silage)	0.0	.1	1.9	1.3
Sorghum (sirup)	.9	.4	.4	.5
Watermelons	.3	.1	(2)	.1
Peanuts	1.4	.6	.4	.6
Sweetpotatoes	1.0	.6	.7	.7
Garden and orchard	1.9	1.7	1.3	1.4
Idle cropland	4.1	4.8	1.4	2.3
Rotation pasture	0.0	0.0	.4	.2
Other cropland	0.0	.6	.1	.1
Total cropland	101.3[1]	101.7[1]	104.6[1]	103.5[1]
Winter cover crops	4.4	5.5	1.1	1.7

[1] The proportion over 100 percent represents the acreage double-cropped in hay and oats.

[2] Less than 0.05 of one percent.

Hogs On Farms

Comparatively few hogs are raised in the Prairie. They are kept mainly for home use, but some farmers raise a few surplus pigs to sell to their neighbors who do not have brood sows. A few of the larger farms raise hogs for the market. Tabulations from a sample of AAA farm plan sheets of the Prairie farms in Clay, Lee, and Monroe Counties showed that most of the farms had between 1 and 4 hogs at the end of 1942, while 14 percent had no hogs, and a few had as many as 100 head. See table 14. The proportion of these farms having specified numbers of brood sows are shown in table 15. Approximately 44 percent of the farms had no brood sows, 37 percent had 1 or 2, and a few of the larger farms had as many as 20, at the end of 1942.

Chickens On Farms

Poultry enterprises in the Prairie are maintained largely for home use, although most farmers sell some eggs during the period of heavy production and generally sell a few fryers. The sample of AAA farm plan sheets studied for the Prairie farms shows that 31 percent of the farms had 25 hens or less, 56 percent had between 25 and 100, and 14 percent had more than 100, at the end of 1942. See table 16. Calculations from the same data show that 12 percent of the farms raised 20 chickens or less, 64 percent raised between 20 and 100, and 24 percent raised more than 100 in 1942. See table 17.

Fertilizers Used and Crop Yields

The use of commercial fertilizers in the Northeast Prairie is low, and is confined almost exclusively to cotton. Of the 108 farmers who furnished complete schedules, only 48 percent reported the use of commercial fertilizer on any cotton acreage in 1942. The proportion of the total cotton acreage

Table 13. Milk cows on farms: percentage distribution of farms by size groups having specified numbers of milk cows, Northeast Prairie Area, end of year, 1942

Size of farm		Number of cows on farms													
		0	1	2	3-4	5-6	7-8	9-10	11-15	16-20	21-25	26-50	51-100	101-200	Total
One-family	Pct.	9	9	22	17	17	12	6	5	2	1	0	0	0	100
Two-family	Pct.	5	3	13	27	16	11	3	16	3	3	0	0	0	100
Three-family or larger	Pct.	4	1	9	12	13	11	11	11	6	8	5	6	3	100
All sizes	Pct.	6	5	16	17	15	11	7	10	4	4	2	2	1	100

Source: Farm plan sheets of the county AAA offices on a sample of approximately 12 percent of the farms in the Prairie Area of Clay, Lee, and Monroe Counties. The sample varied slightly and was somewhat below 12 percent, due to incomplete reports for some of the farms.

Table 14. Hogs and pigs on farms: percentage distribution of farms by size groups having specified numbers, Northeast Prairie, end of year, 1942

Size of farm		Number of hogs and pigs on farms												
		0	1	2	3-4	5-6	7-8	9-10	11-15	16-20	21-25	26-50	51-100	Total
One-family	Pct.	15	21	14	32	8	1	1	4	3	1	0	0	100
Two-family	Pct.	16	8	19	14	13	11	8	3	3	5	0	0	100
Three-family or larger	Pct.	12	3	6	14	8	9	10	6	11	2	10	9	100
All sizes	Pct.	14	11	12	22	9	6	6	5	6	2	4	3	100

Source: Farm plan sheets of the county AAA office on a sample of approximately 12 percent of the farms in the Prairie Area of Clay, Lee, and Monroe Counties.

Table 15. Brood sows: percentage distribution of farms by size groups having specified numbers of sows, Northeast Prairie, end of year, 1942

Size of farms		Number of sows on farms										
		0	1	2	3	4	5	6-8	9-11	11-15	16-20	Total
One-family	Pct.	55	21	18	3	2	0	0	0	0	0	100
Two-family	Pct.	43	24	22	5	3	0	3	0	0	0	100
Three family or larger	Pct.	31	15	16	13	6	6	1	5	3	4	100
All farms	Pct.	44	19	18	8	4	3	1	2	1	1	100

Source: Farm plan sheets of the county AAA offices on a sample of approximately 12 percent of the farms in the Prairie Area of Clay, Lee, and Monroe Counties.

Table 16. Chickens: percentage distribution of farms by size groups having specified numbers of hens and pullets, Northeast Prairie, end of year, 1942

Size of farms		Number of hens and pullets on farms										
		0	1-5	6-10	11-25	26-50	51-100	101-250	251-500	501-750	751-1000	Total
One-family	Pct.	2	1	5	33	35	24	0	0	0	0	100
Two-family	Pct.	8	0	8	22	49	13	0	0	0	0	100
Three-family or larger	Pct.	4	3	1	6	23	26	30	4	2	1	100
All farms	Pct.	4	2	4	21	33	23	11	1	1	(1)	100

[1] Less than 0.5 of 1 percent.

Source: Farm plan sheets of the county AAA offices on a sample of approximately 12 percent of the farms in the Prairie Area of Clay, Lee, and Monroe Counties.

Table 17. Chickens raised: percentage distribution of farms by size groups, raising specified number of chickens in 1942

Size of farm		Number of chickens raised on farms											
		0	1-20	21-40	41-50	51-75	76-100	101-250	251-500	501-750	751-1000	Over 1000	Total
One-family	Pct.	6	9	16	17	17	21	11	3	0	0	0	100
Two-family	Pct.	5	3	24	5	25	33	5	0	0	0	0	100
Three-family or larger	Pct.	5	4	4	13	6	23	5	12	2	4	2	100
All farms	Pct.	6	6	13	13	14	24	15	6	1	1	1	100

Source: Farm plan sheets of the county AAA offices on a sample of approximately 12 percent of the farms in the Prairie Area of Clay, Lee, and Monroe Counties.

that was fertilized was 37 percent. Only 8 percent reported the use of commercial fertilizer for corn, and only 2 percent of corn acreage was fertilized. See table 18.

Other data show that a majority of farmers had very low yields, both of cotton and corn. Table 19 gives a distribution of Prairie farms by 5-year average cotton yields. In Clay County, 65 percent averaged one-third bale or less; in Monroe, 33 percent averaged one-third bale or less; but in Lee, none came in this class. In Clay 86 percent, in Monroe 58 percent, and in Lee 26 percent averaged less than a half bale to the acre. In Lee County 40 percent averaged over 333 pounds per acre, in Clay County only 3 percent.

The average cotton yield for each of the three counties is shown in table 20, for the 5-year period 1938-42. The State average in this period was 305 pounds. For Lee the average was 254 pounds; for Monroe, 215; and for Clay, 186 pounds. The table shows that yields have, in this period, fluctuated widely; whether these are unusual fluctuations is not clear.

Of 41 farmers using fertilizer, 29 had cotton and cottonseed sales over $49 per cotton acre; but of 51 farmers not using fertilizer for cotton, 39 had sales of less than $50 per cotton acre. See table 21. In other words, 70.7 percent of all farmers who had sales of over $49 per cotton acre used fertilizer, and 76.5 percent of those having sales of $49 or less per cotton acre did not use fertilizer.

In Lee County, where cotton yields were highest, 28 farmers used fertilizer for cotton and 4 did not; in Clay, where yields were lowest, 3 used fertilizer, and 23 did not; while in Monroe, which had middle rank in yields, 10 used fertilizer and 24 did not. See table 22.

These five tables (tables 18 to 22), taken together, offer strong evidence that the use of fertilizer for cotton resulted in much larger yields. This is confirmed by the statements of 34 farmers who had definite opinions as to

Table 18. Commercial fertilizers used on cotton and corn, and percent of total cropland planted in winter legumes, Northeast Prairie, 1942

Cotton		Corn		Percent of total cropland planted in winter legumes
Percent of farmers using any fertilizer on	Percent of acres in area fertilized	Percent of farmers using any fertilizer on	Percent of acres in area fertilized	
48	37	8	2	4

Source: The 108 sample farms studied in Clay, Lee, and Monroe Counties.

Table 19. Sample Prairie farms classified by range in 5-year average cotton yields, Northeast Prairie, 1938-42

	Percent of farms by counties			
Pounds lint per acre	Clay	Lee	Monroe	All three
Under 100	14	0	9	7
100-166	51	0	24	25
167-199	16	5	15	12
200-249	5	21	10	12
250-333	11	34	27	24
334 and up	3	40	15	20
Total	100	100	100	100

Source: AAA records for the sample farms surveyed in the study of which 37 farms were in Clay County, 38 in Lee, and 33 in Monroe.

Table 20. Cotton yields: weighted averages in pounds of lint per acre for three sample Prairie counties, 1938-42

Year	Percent of farms by counties			
	Clay	Lee	Monroe	All three
1938	223	285	254	261
1939	81	141	163	139
1940	74	199	153	156
1941	134	272	203	219
1942	266	370	306	325
5-year average	186	254	215	219

Source: Records of State AAA office.

Table 21. Distribution of farmers by value of cotton and cottonseed sales per cotton acre[1], and by use of fertilizer for cotton, Northeast Prairie

Item	Number of farmers having sales of value of					Total
	Under $40	$40-$49	$50-59	$60-$79	$80-$99	
Number using fertilizer	9	3	14	10	5	41
Number not using fertilizer	31	8	9	2	1	51
All farmers	40	11	23	12	6	92

[1] Values have been adjusted to the 1939-43 average production and prices.

Source: Farm schedules of Black Prairie Study. Only those farms classified as typical in organization are included in this table.

Table 22. Distribution of farmers[1] by use or nonuse of fertilizer, by counties, Northeast Prairie, 1942

Number using fertilizer			Number not using fertilizer		
Clay	Monroe	Lee	Clay	Monroe	Lee
3	10	28	23	24	4

[1] The table presents data only on farmers classified by type of farming.

Source: Farm schedules of Prairie study.

the amount of increase they averaged from the use of fertilizer. The average of their estimates is an increase of 156.7 pounds of lint per acre. Two were of the opinion that there was no increase; others had no opinion because they had never used fertilizer, and others had used fertilizer only one or two years. Nitrate, potash, or both, and mixed fertilizers such as 4-8-4 or 6-8-8 were the fertilizers most commonly used for cotton in 1942.

Many farmers who did not use fertilizer for cotton in 1942 reported that they had never in their entire farming experience used any fertilizer for crops. While there was a scarcity of fertilizers in 1942, and farmers in some instances reported that they could not obtain the quantities or the kinds they wished, it is clear that many farmers did not use commercial fertilizers because they were not convinced that they would profit by their use.

Fertilizer experiments conducted in the area show that liberal applications of fertilizers on cotton are profitable. This fact, with low average cotton yields, indicates the need for a great expansion in quantities of fertilizers used. Experiment Station agronomists recommend for cotton on black Prairie upland soils 200 pounds of superphosphate plus either 200 pounds of nitrate of soda or 100 pounds of ammonium nitrate, and in local areas, potash. The recommendation for cotton on red Prairie or "post oak" lands is the same plus a potash material furnishing 18 pounds of potash. Instead of the latter mixture, 400 pounds of 6-8-4 may be used. Experiments with

4-8-4 fertilizer on cotton show that net returns increase with increased applications up to 1200 pounds per acre in the area.[3] The general recommendation for 4-8-4 was 600 pounds per acre when available.

Corn Yields and Fertilization

As compared with the State average, corn yields were very good in the Prairie in 1942. The weighted average for the sample farms studied was 19 bushels per acre. Although long-time average yield data are not available, it was the opinion of many farmers that because of an unusually favorable season, the 1942 yields were above average.

Experiment Station agronomists believe that it would be profitable for farmers to apply 200 pounds of nitrate of soda or 100 pounds of ammonium nitrate, or the equivalent to corn. It is their opinion that the use of potash or phosphate for corn is not profitable, except in local small areas.

Another point worthy of consideration with respect to average corn yields is the relation of the yields of individual farmers to the average. Approximately 60 percent of the farmers had yields less than the average, which was 19 bushels; 38 percent had yields of 15 bushels or less; and 14 percent had yields of 10 bushels or less. See table 23. Under these conditions, there is considerable room for improvement in corn production practices.

Hay Yields

The weighted average yield of all hay was 0.81 tons per acre for the sample farms studied in 1942. The highest yields were obtained from soybeans and cowpeas which averaged 0.92 tons. Johnson grass was by far the most important hay crop. It accounted for 60 percent of all hay acreage and produced an average yield of 0.84 tons per acre. See table 24. Johnson grass is a volunteer growth, is well adapted to the area, and if properly harvested, produces a good yield of hay of satisfactory quality. It is a nuisance in connection with clean row crops, but it gives the farmers in this area an advantage in the production of hay. Other hays also grow well in the area, and many farmers could profit by giving more of their time and effort to their production.

Table 23. Corn yields: percentage distribution of farms by range in weighted average yields, Northeast Prairie Area, 1942

Bushels per acre						Total weighted
10 or less	11-15	16-20	21-25	26-30	31 and over	av. yield (bu.)
14 percent	24 percent	24 percent	12 percent	15 percent	11 percent	19

Source: The 108 sample farms studied in the survey in Clay, Lee, and Monroe Counties.

Table 24. Distribution of hay acreage and weighted average yields by kinds, Northeast Prairie, 1942

Item	Hay crops in					
	Johnson grass	Pea and bean	Lespedeza	Alfalfa	Oat	Total
Percent of hay acreage	60	17	14	5	4	100
Average yield (ton)	0.84	0.92	0.62	0.87	0.60	0.81

Source: The 108 sample farms studied in the survey in Clay, Lee, and Monroe Counties.

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[3] Andrews, W. B., **Profit from $100 Spent for Cotton Fertilizer,** Mississippi Experiment Station Bulletin No. 342, 1940.

Feeding Practices

The relation of feeds fed to numbers of livestock kept indicates that feeding rates are far too low to insure best returns from livestock enterprises. The kinds and quantities of feeds recommended for the different classes of livestock are shown in table 25. By determining the average livestock organization and calculating the needed feeds based on these recommendations, a comparison between feeds needed and feeds used has been made for different types of farms. The calculations were made only for one-family size farms, since the numbers and kinds of livestock kept by tenants on multiple-family size farms as well as the quantities of feeds available to tenants' livestock was not known. The comparisons on these farms, however, indicate rather well the feeding practices followed on all farms in the area.

Grain feeds, which consist almost entirely of corn, were sufficient to meet the quantities recommended on practically all farms in the area, with the exception of the group classified as general farms.[4] The general farms, on the average, had only about 75 percent of the corn recommended, while some of the type-of-farm groups exceeded the quantity recommended. See table 26. In the case of roughages, all farms studied were greatly deficient

Table 25. Kinds and quantities of feed recommended for livestock in the Northeast Prairie[1]

Kind of animal	Kinds and quantities of feed per head per year		
	Corn (bu.)	Hay (ton)	Pasture[2] (acres)
Work animal	40.5	2.0	2.0
Dairy cow	15.0	2.0	4.0
Beef cow	3.0	0.8	4.0
Calf or yearling	0.0	0.4	2.0
Meat hog[3]	15.0	0.0	0.2
Sheep and goats	0.0	0.1	0.4
Poultry (1 hen)	1.0	0.0	0.0

[1] In addition to these feeds, the following purchased feeds are recommended: 400 lbs. cottonseed meal per dairy cow, 1750 lbs. mash feed per 40 hens. For food, a family of 5 is estimated to require 22.5 bushels of corn.

[2] Composite of woodland and open pasture.

[3] The requirements for hogs were based on information secured from farmers in the study.

Source: Steanson, Oscar, and Langsford, E. L., "Food, Feeds and Southern Farms," Bureau of Agricultural Economics, Washington, D. C., November, 1939.

Table 26. Percentage of recommended feeds fed on one-family size farms, by type of farm, Northeast Prairie Area, 1942

Farm type[1]	Percentage of recommended feeds used[2]			
	Corn	Hay	Pasture	Cottonseed meal
Cotton	97	59	80	41
Cotton-livestock	124	79	91	29
Cotton-dairy	101	59	66	184
General	74	56	60	13
All farms	93	63	75	66

[1] For a description of farm types, see page 26.

[2] To arrive at the quantities of feeds needed, the requirements as shown in table were applied to the average number of livestock kept on each type of farm as determined from the sample farms studied.

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[4] The basis used for classifying farms by type is shown on page 26.

in the quantities fed. The average level of hay feeding on all one-family size farms was 63 percent of the quantity recommended. The group coming nearest the recommended quantity fed only 79 percent of that amount. According to these standards, pasture acreage is likewise deficient, the average of all the farms studied being only 75 percent of the acreage recommended. It is well to note, however, that the recommended pasture acreage as based on average conditions of present pasture is quite liberal. The desired quantities of grazing could be obtained from a much lower acreage of pasture if more care were given to improving the carrying capacity per acre. It would, in most cases, be more economical to increase grazing through improved methods of handling present pasture acreage than through increasing the number of acres.

The quantities of purchased feeds were likewise below those recommended. In the case of cottonseed meal for dairy cattle, the one-family size farms used, on an average, only 66 percent of the quantities recommended. On the dairy farms, however, the quantity used was 84 percent above that recommended.

The average milk production per cow on all the sample farms which had a commercial dairy enterprise was 2,768 pounds. This is approximately 322 gallons, or less than a gallon per day per cow for the year. The average butterfat test for all milk sold in 1942 was 4.5 percent. The 5-year average price for this quality milk was $1.92 per hundredweight. This production at these prices gives a gross return of $53.14 per dairy cow. The dairy farmers could, in all probability, increase their net profits considerably through feeding of much more roughages and less purchased concentrates.

In the case of purchased feeds for poultry, less than 1 percent of the quantity recommended was used.

Pastures

The extent to which dairying and the production of beef cattle are dependent upon pastures in the Prairie is indicated by data for milk deliveries to processing plants. Sixteen sample farms which sold milk to one plant delivered 48 percent of the total for 1942 in the 12-week period beginning May 3 and ending August 22; 82 percent in 32 weeks from May 3 to November 14; and only 18 percent in the other 20 weeks.

It is significant that deliveries averaged 18,500 pounds for 8 weeks ending July 25; 16,700 pounds for 4 weeks ending August 22; 10,700 pounds for 4 weeks ending September 19, and 6,300 pounds for 8 weeks ending November 14. The data suggest that farmers would profit by providing supplemental temporary pastures for use during the hot dry summer months and by providing an ample supply of home-grown winter feed. It is recognized that there is a normal decline in milk production after the calving period early in the year, but farmers generally stated that the decline is largely accounted for by failure of pastures.

Farmers reported that their pastures were, for the most part, on their older, sloping, and more eroded soils, and in large part on red soils low in lime. They also reported that clovers grew more generally in the Prairie in former years than now. These data suggest the need for fertilization of pasture soils.

The principal recommendations of specialists at the Mississippi Experiment Station regarding Prairie pastures are as follows:[5]

1. The application of 200 to 400 pounds of superphosphate or 500 to 800 pounds of basic slag per acre per year.
2. The application on noncalcareous (the red) soils of 500 to 1,000 pounds of lime every fifth year.
3. Seedings of pastures with mixtures adapted to soils and varied to make pasturage for different seasons.
4. Regular mowing (twice per year as a rule).

Credit Practices

The subject of credit is of special importance to all farmers. Farming requires a comparatively large investment as related to the returns therefrom. Unlike other businesses, many types of farming provide no regular income throughout the year; instead, the farmer must wait until the harvest season before he receives any returns for his labor or from his investment. Most of operating expenses and a great part of his living expenses for the year must be met before harvest. For these reasons most farmers are obliged to rely on borrowed money to help them to become owners of their farms and to carry them from one year's harvest to the next.

The types of credit offered and the policies of the agencies supplying the loans are important factors in determining the kinds of farming carried on. Agencies having money to lend are, for their own safety, reluctant to make loans for new enterprises which have not become established and have not been proved to be sound for the locality. This restraint on credit for new enterprises is sometimes helpful to the farmer by preventing him from going into something new that may prove to be a pitfall. On the other hand, there may be cases where farmers are compelled, for lack of funds, to continue farming enterprises that are not the best for them or for society, merely because these enterprises happen to be better known and to conform more closely to the policies of the credit agencies.

The kinds of credit farmers in the study used are grouped under three headings which are defined as follows: (1) Short term credit, that used for the purchase of items used up within the crop years, including family living, and outstanding for 1 year or less; (2) intermediate credit, that used to purchase durable production goods, such as livestock and machinery, and outstanding from 1 to 5 years; (3) mortgage credit, that used for the purchase or refinancing of real estate, and outstanding for 5 years or longer.

Short Term Credit

Short term credit was used on 53 percent of the 108 sample farms studied in 1942. See table 27. The proportion using credit was slightly less on one-family farms. On multiple-family farms the proportion was somewhat higher, the explanation being that on these farms where there was one or more tenant family, the operator often borrowed furnish money for tenants which he otherwise would not have had to borrow. The average amount of short term credit per farm for all users, irrespective of size of farms, was $375. This average amount on the one-family farms was $139; on the two-family farms,

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[5] See Mississippi Experiment Station Bulletin Number 356, **Pastures in Mississippi**, by H. W. Bennett, for a full discussion of the subject. Also, for crawfish control, see a Mississippi Experiment Station bulletin now in preparation by Dr. Clay Lyle.

$199; and on the larger farms, $768. The greater number of these loans were made by local banks and merchants; the banks supplying 50 percent and the merchants 33 percent of the total number of loans made. The reported rates of interest on short term loans ranged from less than 4 to 10 percent, 63 percent ranging from 8 to 10 percent. See table 27.

As stated above, one of the reasons why a consideration of credit is highly important to farmers is that their income is not distributed throughout the year. In this connection it is of interest to note the effect that different combinations of farm enterprises have on the distribution of the farm income and in turn on the relation that these various combinations of enterprises have to farmers' credit needs. On the sample farms 60 percent of the one-family farm operators, and 89 percent of the operators of two-family size farms used short term credit. But on the cotton-dairy farms, the proportion of farmers using short term credit was only 12 percent on the one-family size farms and only 29 percent on two-family size farms. When asked about furnish money, many farmers replied, "The cow provides that." The other types of farms having commercial livestock enterprises also used less short term credit on the average than did those having only cotton as a cash enterprise. See table 28.

Intermediate Credit

Of the sample farms studied, only 13 percent had intermediate loans outstanding in 1942. Of these loans 40 percent were made by the Farm

Table 27. Short term credit: percentage distribution of farmers using, by size of farm and by source, and average amount for those using, Northeast Prairie Area, 1942[1]

Size of farm	Percent of farmers using	Source[2]					Average amount for those using
		Percent loans from:					
		P. C. A.	Local bank	Merchant	F. S. A.	Seed loan	
One-family	46	5	37	42	11	5	$139
Two-family	57	0	77	23	0	0	199
Multiple-family	57	13	56	25	6	0	768
All farms	53	7	50	33	8	2	375

[1] 8 percent of the loans bore interest of 4 percent or less; 17 percent had rates of 5 to 7 percent; 63 percent had rates of 8 to 10 percent, and for 12 percent the rates were unknown.

[2] P. C. A., Production Credit Association; F. S. A., Farm Security Administration; Seed Loan, the Federal Seed Loan.

Source: Sample farms of Prairie Study.

Table 28. Short term credit: proportion of farmers using and average amounts for those using by size and type of farm, Northeast Prairie, 1942[1]

Farm type[1]	One-family size farms		Two-family size farms	
	Percentage of farmers using	Average amount for those using	Percentage of farmers using	Average amount for those using
Cotton	60	$220	89	$242
Cotton-livestock	37	272	xxx[3]	xxx[3]
Cotton-dairy	12	50	29	225
General	60	132	xxx[3]	xxx[3]
Livestock-cotton	xxx[3]	xxx[3]	43	68

[1] On the farms having three-or-more families, dairying was of less relative importance, and there were more tenants to be furnished. For these reasons the variations in the use of short-term credit by type of farm were less on these than on the smaller farms.

[2] For a definition of the farm types see page 26.

[3] None classified as such in the sample.

Security Administration, 36 by the Production Credit Association, and 24 percent by individuals. The prevailing rate of interest was 6 percent or less, and according to farmers' statements, about one-third had interest rates of 4 percent. See table 29. These loans were usually made for the purpose of buying livestock and machinery; they were sometimes used for buying fencing and improving pastures. If used judiciously, many farmers could profit by loans of this kind to help them in diversifying their farm organizations and in improving the efficiency of their farming operations.

Mortgage Credit

Of the owner-operated farms studied, 56 percent had mortgages outstanding at the beginning of 1942. The proportion of farms mortgaged was somewhat higher on the one- and two-family size farms, and was considerably less on the larger farms. The average amount of indebtedness per mortgaged farm was $2,079 at the beginning of the 1942 crop year, being less on the smaller size farms. See table 30. The greater number of these mortgages were held by the Federal Land Bank; about one-fourth were held by Farm Security Administration on account of loans made under the Tenant Purchase Program. Mortgage credit is often very helpful to farmers in facilitating their becoming owners and in helping them to carry on through periods of un-

Table 29. Intermediate credit: percentage distribution of farmers using, by size of farm and by source, and average amount of those using, Northeast Prairie, 1942[1]

Size of farm	Percent of farmers using	Source[2] Percent loans from: P. C. A.	F. S. A.	Individual	Average amount for those using
One-family	15	33	67	0	$463
Two-family	9	50	50	0	450
Multiple-family	11	33	0	67	659
All farms	13	36	40	24	531

[1] 32 percent of the loans bore interest rates of 4 percent or less; 48 percent bore rates of 5 or 6 percent; 12 percent bore rates of 7 or 8 percent; while on 8 percent the rates were unknown.

[2] P. C. A., the Production Credit Association; F. S. A., the Farm Security Administration.

Source: The 108 sample farms of the Black Prairie Study.

Table 30. Mortgage credit: percentage distribution of owner-operated farms mortgaged, by size of farm and by source of credit, and average amount outstanding per mortgage, Northeast Prairie, January 1, 1942[1]

Size of farm	Percent of farms mortgaged	Percent from: F. L. B.	F. S. A.	Individual	Average amount outstanding per mortgage
One-family	63	26	53	21	$ 862
Two-family	61	82	8[2]	10	1881
Multiple-family	39	95	2[3]	3	4766
All farms	56	63	24	13	$2079

[1] 10 percent of the mortgages were made for 10 years or less, 44 percent for 10 to 20 years, and 46 percent above 20 years. 71 percent of the loans bore interest rates of 4 percent or less, 27 percent bore rates of 5 or 6 percent, and 2 percent bore rates of 7 or 8 percent.

[2] F. L. B., the Federal Land Bank; F. S. A., Farm Security Administration.

[3] These farms have only one resident family, but have land rented out equivalent to that usually farmed by the number of tenants indicated.

Source: Farm schedules of Prairie Study.

favorable years. It should, however, be used with discretion and avoided unless amply justified. The presence of mortgages on a large proportion of farms in an old settled area is generally an indication that the agriculture has been in an unfavorable financial condition. It was noted, however, that many farmers were making prepayments on loans, and that some mortgages were being paid off.

Patterns of Farm Operating Units With Comparisons

This section describes the existing patterns of farm operating units in terms of size and type of farm, and attempts to appraise the relative merits of each size and type. The cropland and livestock organization are described in detail for each type of farm within each of three size groups based on the number of families employed on the farm. These groups of farms by size are designated as follows: (1) one-family size farms, those farms operated entirely by the operator and his family or supplemented with a little hired day labor; (2) two-family size farms, those farms having in addition to the operator's family, one other family that may be either a cropper, a tenant, or a wage family regularly employed on the farm, and (3) farms having in addition to the operator's family two or more other families regularly employed on the farm. In this bulletin, this last group is called "multiple-family farms."

Types of Farms and Basis Used for Classification

The method used in classifying the farms into type classes is essentially the same as that employed by the Census Bureau, with some modification to adapt the system more closely to local conditions. The type classification of a given farm is determined by the proportion of the farms' "normalized" gross income which comes from a given source or farm enterprise.

After the "normalized" gross farm income had been determined for the farms, they were each placed into one of the following six classes on the basis indicated below:

1. **Cotton farms.** Those having 40 percent or more of their gross income from cotton, including the cotton price adjustment payment made by the AAA, and having less than 20 percent from the sale of livestock, livestock products, and increases in livestock inventories.

2. **Cotton-dairy farms.** Those having 40 percent or more of their gross income from cotton, as above, and having between 20 and 40 percent from the sale of dairy products.

3. **Cotton-livestock farms.** Those having 40 percent or more of their gross income from cotton (as in 1 above) and having between 20 and 40 percent of their gross income from the sale of all livestock and livestock products plus changes in livestock inventories, but having less than 20 percent from either dairy products or beef cattle.

4. **Livestock-cotton farms.** Those having 40 percent or more of their gross income from the sale of all livestock, livestock products, and changes in livestock inventories combined, but having less than 40 percent from either dairy products or beef cattle, and having between 20 and 40 percent from cotton, including the price adjustment payments made by the AAA.

5. **Beef cattle-cotton farms.** Those having 40 percent or more of their

gross income from the sale of beef cattle plus changes in beef cattle inventories, and having between 20 and 40 percent from cotton.

6. **General farms.** Those having less than 40 percent of their gross income from either cotton or the combined sales of livestock and livestock products plus changes in livestock inventories. Home-used products made up a large proportion of the income from these farms.

Of 108 farms on which complete schedules were obtained, 92 were found to be typical of the agriculture of the area, and the type studies deal with that number. The others were so preponderantly engaged in commercial dairying or were for other reasons such unusual cases, that they were not included in the type studies.

Of the sample farms studied by type in 1942, 38 percent fell in the cotton type, 17 percent in the cotton-livestock type, and 16 percent in the cotton-dairy type, leaving 29 percent in the other three types of farms. The proportion of farms classified into each group varied by size of farms; some types do not occur in all three of the size of farm groups. See table 31.

Efficiency Comparisons of Types of Farms by Size Groups

Following is a description of the various types of farms showing in detail the size of farm, the cropland and livestock organization, the size of the labor force, the number of days of employment the farm provides for the labor force, the farm investment, and finally the financial returns accruing to the operator and his family on the average farm of each type classification. These descriptions and comparisons of the farm types are made within three size-of-farm groups, viz., one-family, two-family, and multiple-family size farms.

Adjustments Made in Farm Prices and Related Items

Changing price levels cause the monetary income of a farm to fluctuate widely from one year to another, although the same quantity and quality of products may be produced. The fluctuating prices of individual products likewise cause the relative proportions of a farm's gross income from different sources to change from one year to another, although the physical production from the various enterprises may be held constant. For example, a farm may produce cotton and milk for sale. One year the price of cotton is up and the price of milk is down; the milk sales may then amount to so small a fraction of the farm's gross income that the farm might be classified into the cotton type group. Some other year the milk prices may be up and cotton prices down; the farm might then easily be classified into the cotton-dairy type, although the physical production of cotton and dairy products were the same

Table 31. Distribution of farms by type classification, by size of farm groups, Northeast Prairie Area, 1942

Size of farm	Percent of farms in type classification						
	Cotton	Cotton-dairy	Beef cattle-cotton	Cotton-livestock[1]	Livestock-cotton[1]	General	All types
One-family	37	19	0	20	0	24	100
Two-family	39	31	0	0	30	0	100
Multiple-family	39	0	18	29	14	0	100
All farms	38	16	6	17	12	11	100

[1] A high proportion of the livestock receipts on these farms is from dairying.

Source: Farm schedules of Prairie Study.

for both years. In an effort to lessen these effects of price fluctuations, the prices that farmers paid for items bought for use in connection with the farm business, and the prices they received for their farm products sold or used in the home, were adjusted to the average of prices prevailing in the area during the 5-year period, 1939-43.[6] It is believed that this average of prices will more nearly represent the prices that may be expected in the near future and that the income calculations will hold true over a longer period of time than they would if based on only one year. The income calculations on the types of farms to follow are based on these average prices and are referred to as "normalized" farm incomes.

Since cotton yields fluctuate so widely in the Prairie and they were unusually good in 1942, the yield of each farm was adjusted to its 5-year average or to 70 percent of the 1942 yield, whichever was higher. The 5-year average yield of the three sample counties was 70 percent of the 1942 yield. It should be pointed out at this point that comparative incomes for farms producing various types of products can be determined only under a given set of prices for the different products. Should the prices of cotton drop relative to that of livestock or livestock products, or vice versa, the income calculations would

Table 32. One-family size farms: land use and cropland and livestock organization by types of farms, Northeast Prairie, 1942

Item	Types of farms			
	Cotton	Cotton-livestock	Cotton-dairy	General
Acres in farm	60.4	96.2	65.0	64.1
Cropland	38.9	50.8	30.4	38.1
Open pasture	9.3	27.7	23.6	18.2
Woods pasture	6.8	7.4	0.0	1.0
Woods not pastured	1.4	5.6	2.6	4.4
Other land	4.0	4.7	8.4	2.4
Cropland acres in				
Cotton	10.9	15.6	9.8	9.3
Corn	12.8	18.6	9.6	10.7
Oats	0.3	1.2	1.5	0.0
Peas (seed)	2.0	0.0	0.1	1.0
Beans (seed)	0.1	0.0	0.6	0.3
Johnson grass hay	3.1	5.2	4.0	8.1
Other hay	5.7	8.0	2.9	4.8
Peanuts (nuts)	1.0	0.3	0.1	0.5
Garden and truck	1.9	1.4	0.8	1.9
Idle cropland	1.6	1.1	1.0	2.5
Other cropland	0.0	0.0	0.0	0.0
Livestock numbers				
Workstock	3.0	3.0	3.0	2.0
Milk cows	3.0	6.0	6.0	5.0
Beef cows	0.0	0.0	0.0	0.0
Steers	0.0	0.0	0.0	0.0
Sows	1.0	1.0	1.0	1.0
Meat hogs	2.0	2.0	2.0	2.0
Chickens	30.0	46.0	42.0	32.0

Source: Sample farms in Prairie Study.

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[6] See Appendix tables 2, 3, and 4. Appendix table 5 shows the charges made against farm income for operational cost of cars and trucks used in the farm business.

then be in error. The degree of error would depend upon the relative price changes for the two sets of products.

One-Family Size Farms

The sample one-family size farms were classified into four type groups: (1) cotton, (2) cotton-livestock, (3) cotton-dairy, and (4) general. See tables 32 and 33.

Cotton farms. The average one-family size cotton farm had 60 acres of farm land. Approximately 40 acres of this was cropland, and 16 acres pasture land, of which 7 acres was woods pasture. There were few productive livestock on the farm. The "normalized" net cash returns accruing to the operator and his family after deducting cash farm expenses was $539, a large proportion of which came from cotton sales. After adding the value of home-used products to the gross cash income and deducting all farm expenses and 5 percent interest on investment, the total remaining was $580. This was the cash and non-cash income accruing to the operator and his family for labor and management, and was designated family labor earnings.

Cotton-livestock farms. The average farm of this size-type had 96 acres of farm land. Approximately 51 acres of this was cropland and 35 acres pasture, of which 7.5 acres was woods pasture. This average farm had 13 acres in

Table 33. One-family size farms: farm investments, normalized farm incomes, and expenses, by types of farms, Northeast Prairie, 1942[1]

Item	Types of farms			
	Cotton	Cotton-livestock	Cotton-dairy	General
Farm investment:				
Land and buildings	$2,136	$4,071	$2,631	$2,622
Livestock and equipment	736	1,067	852	683
Total investment	2,872	5,138	3,483	2,305
Cash farm income				
Crop receipts	690	850	544	272
Livestock receipts	165	449	659	383
Other cash farm receipts	0	0	0	0
Gross cash farm income	855	1,299	1,203	655
Noncash farm income	314	348	257	316
Total gross income	1,169	1,647	1,460	971
Expenses:				
Cash farm expenses	316	490	641	322
Noncash farm expenses	129	138	112	98
Total farm expenses	445	628	753	420
Net cash farm income (Gross cash income less cash farm expenses)	539	809	562	333
Total net farm income (Total income less total expenses)	724	1,019	707	551
Interest on investment (5 percent)	144	257	174	115
Family labor earnings (Total net income less interest on investment)	580	762	533	436

[1] Incomes and expenses calculated by applying 5-year average prices, 1939-1943, to the 1942 farm sales and purchases. See prices in Appendix tables 2 and 3.

[2] The cotton farm is based on an average of 15 farms, the cotton-livestock on an average of 8 farms, and the general on an average of 10 farms.

hay crops and maintained 6 milk cows. The income from this farm was considerably higher than that from the cotton farm, due to its larger size, more cattle, and more acres in cotton. The net cash income to the family was $809, and the family labor earnings were $762, as compared to $539 and $580, respectively, on the typical cotton farm. The labor forces on the two farms were about equal.

Cotton-dairy farms. The average farm of this size-type group had 65 acres of farm land, with 30 acres in cropland and 24 in open pasture. The farm had 6 milk cows and approximately 10 acres in cotton. The net cash income to the operator and his family was $562 and the family labor earnings were $533. The corresponding income figures on the cotton farm of 60 total acres were $539 and $580, respectively. The cotton farm produced a higher family labor earning than the cotton-dairy farm, but the labor force on the cotton farm was much larger. The returns per man-equivalent worker were considerably higher on the cotton-dairy farms.

General farms. The average farm of this size-type group had 64 acres of farm land, being almost equal to the cotton and cotton-dairy farms in size. It had 38 acres in cropland and 19 acres in pasture. The total cropland was almost equal to that of the average size cotton farm, but it had less acreage in cotton and corn. The farm kept five milk cows. The organization was well diversified and probably combined the cotton and dairy enterprises in the right proportion, but the size of the two enterprises combined was too small to yield a good return. The net cash income was $333 and the family labor earnings were $436. The comparable returns on the cotton-dairy farms of similar size were $562 and $533. The labor force on the general farm was larger than that of the dairy farm. The returns per man-equivalent worker were much higher on the dairy farms.

Returns Per Man-Day of Labor by Types of Farms

The net returns per day of labor were highest on the general and cotton farms. These farms got a large proportion of their income from cotton and home-used products. On the cotton-dairy and cotton-livestock farms, where a considerable proportion of the income was from livestock, the net returns per day of labor were lower. See table 34. This is evidence that the net returns per day worked were higher from cotton than from livestock enterprises. Net returns from cotton were higher per day of work or per acre of land than for any other commercial enterprise found in the area. For this reason cotton should be given an important position in the organization of most farms, especially where the farm acreage is limited. There are factors other than returns per day of labor; however, that must be considered in the operation of the farm if it is to yield the maximum annual net returns. It is often advantageous to include enterprises in the farm organization which do not produce the highest net returns per day of work. Some of these enterprises help to distribute the labor requirements throughout the year and thereby help to increase the total days of work made available to the labor force. The total net returns to a farm family may be increased by their being employed more days even if at a slightly less return per day.

Annual Employment and Income per Man-Equivalent Worker by Types of Farms

Labor is one of the most important resources that the farmer has at his disposal. The financial outcome of the farm is largely dependent upon the

Table 34. Income per man-day of work by types of one-family size farms, Northeast Prairie, 1942[1]

Type	Income per man-day of work			
	Gross cash	Net cash	Total net (cash and noncash)	Total net[2] above interest on investment
General	$2.77	$1.41	$2.33	$1.92
Cotton	2.68	1.69	2.27	1.82
Cotton-dairy	4.04	1.89	2.37	1.79
Cotton-livestock	2.98	1.87	2.34	1.75

[1] Income calculations based on 5-year average prices, 1939-43; days of work calculated by applying average labor requirements, as shown in Appendix table 1, to crops and livestock on the farms.

[2] Deducting interest on investment from total net returns gives the income for labor and management; it is designated as labor earnings. See table 33.

degree of full and efficient utilization of the labor force. On the sample farms studied in 1942, it was found that the net incomes varied directly with the number of days of employment irrespective of the returns per day of work. Although the net returns per day of work were higher on the farms which produced relatively more cotton and kept less productive livestock, the annual returns per worker were higher on the farms which kept the greater numbers of livestock because of the greater number of days employment provided the labor forces on these farms. In order to facilitate a comparison of employment and returns for the different types of farms, the calculations have been reduced from the family unit to the size of families on the farms. It would be misleading to compare the income for a family of three workers to that of a family of two workers. The families varied from 1.6 man-equivalent workers on the cotton-dairy farm to 2.5 on the cotton and cotton-livestock farms. See table 35.

On the average general farm each worker was employed only 116 days and the labor earnings per man-equivalent were $222. On the cotton farm, the days of employment were 128 and the labor earnings $232; on the cotton-livestock farm, the days of employment were 175 and the labor earnings $306; and on the cotton-dairy farm, the days of employment were 192 and the labor earnings were $344.

After the income and factors of farm organization have been determined on a per worker basis for the representative farms, they may then be combined in the same proportions to show comparisons of a farm operated under

Table 35. Days of employment, number of milk cows, cotton acres, and normalized income per man-equivalent worker, by type of one-family size farms, Northeast Prairie Area, 1942[1]

Farm type	Man-equivalent workers per family[2]	Per man-equivalent worker						
		Days work	Milk cows	Acres cotton	Gross cash income	Net cash income	Total net income	Labor earnings
General	2.0	116	2.5	4.6	$321	$163	$270	$222
Cotton	2.5	128	1.2	4.4	342	215	290	232
Cotton-livestock	2.5	175	3.4	6.3	522	325	409	306
Cotton-dairy	1.6	192	3.9	6.3	776	363	456	344

[1] Income figures from table 18, based on 5-year average farm prices.

[2] Man-equivalent workers calculated as follows: males, 18 years or older = 1; 10 to 18 years = 0.6; females, 10 years or older = 0.3.

different types of organization by a given size labor force. The factors shown above have been combined in the same proportions to standardize the labor force to an average size family of two man-equivalent workers. The total days of employment on the hypothetical farms are exactly twice that for one man-equivalent worker as shown above.

If this family of two man-equivalent workers operated a farm organized as the representative general type farm, and the farm were adjusted in size to provide the same work per worker as the original general farm, the total days of employment on the farm would then be 232, or 58 percent of the family's work capacity; the family labor earnings would be $445; and the farm would be approximately 64 acres in size.[7] See table 36. If this family of two man-equivalent workers operated a cotton farm and the farm were adjusted to provide the same employment per worker as the original cotton farm, the total days of employment would be increased to 256 days, or to 64 percent of the family's work capacity; the family labor earnings would be $464; and the farm would be 53 acres in size. Although the cotton farm has less acreage than the general farm, the family income is greater because of the greater number of days of employment. Similarly, on a cotton-livestock farm adjusted to an average size family, the employment would be 350 days, or 88 percent of the family's capacity; the family labor earnings would be $612; and the farm would be 79 acres in size. On a cotton-dairy farm similarly adjusted for a family of two man-equivalent workers, the total days of employment would be 384, or 96 percent of the family's capacity; the labor earnings would be $688; and the farm would be 77 acres in size. On all the sample farms, as the days of employment on the farm increased, the income accruing to the families was likewise increased. It appears that many farms, by adjustments which will increase the number of days employment, can increase the farm income.

These comparisons show that farm incomes were highest on those farms which employ the labor force for the greatest number of days per year, namely, the cotton-dairy and cotton-livestock farms. The returns per day of work on these farms were lower than those on either the general or the cotton farms, but due to the greater number of days work provided on the cotton-dairy and

Table 36. Days of employment, factors of farm organization, and farm income calculated for a family of two man-equivalent workers employed on different types of farms, Northeast Prairie Area, 1942[1]

Type of farm	Volume per farm						Income per farm		
	Employment[2]	Farm land	Cropland	Pasture[3]	Cotton	Milk cows	Net cash	Total net	Family labor earnings
	days	acres	acres	acres	acres	no.			
General	232	64	38	19	9.3	5	$226	$540	$445
Cotton	256	53	35	13	8.7	2	431	579	464
Cotton-livestock	350	79	41	29	12.5	5	650	812	612
Cotton-dairy	384	77	37	28	12.5	8	726	912	688

[1] Figures from tables 33 and 35 were broken down on a man-equivalent worker basis and calculated for 2 man-equivalent workers.

[2] Based on labor requirements determined for sample farms shown in Appendix table 1.

[3] Composite of open and woods pasture.

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[7] Days per year suitable for field work in the area are estimated at 200. The days of work that a labor force of two man-equivalent workers could put in is twice that, or 400 man-days.

cotton-livestock farms, the annual returns to the labor force are considerably higher. These farms have relatively large volumes of cotton and milk cows. Considering the cotton and dairy enterprises together, these farms have a much larger volume of cash enterprises than have the general and cotton type farms. These two cash enterprises on the cotton-dairy and cotton-livestock farms are combined in such manner as to make for maximum efficiency in the employment of the labor force. The average farm in each of these type groups grows about all the cotton that the labor force can handle during the chopping and picking seasons. By growing the relatively large acreage of cotton the labor force is employed the maximum number of days at relatively high returns per day. The livestock enterprises, especially dairying, fit in well with cotton to provide employment at the times of the year when otherwise there would be little or no work to be done. In this way, the labor requirements are better distributed throughout the year, and the total days of farm employment are greatly increased.

Both of these better paying types of farms have higher acreages in cotton, and they also obtain a greater proportion of their income from cattle, especially the dairy cattle, than do the lower income farms.

Thus under average conditions, the best paying type of organization for the small farm is one that maximizes the combined volume of cotton and commercial livestock enterprises that the family can handle, and that allows a relatively important position for dairy production.

Two-Family Size Farms

The same factors considered in connection with the one-family size farms apply in general to the larger farms. The operators of the larger farms have the same problems of organizing their farms so as to put their land to its best use and to provide maximum employment at the best possible wages for their families and themselves. There are other problems in connection with the larger farms, however, that the small operator is not confronted with. The operator of a large farm must first decide whether to follow an extensive type of farming like the grazing of livestock, thereby utilizing more of his land with his own family, or whether to emphasize row-crop farming and have most of his land worked with tenants. Some larger operators prefer to keep relatively large numbers of livestock themselves, letting the tenants have most of the row crops and depending on the tenants to furnish them with additional labor when they need it. In addition to these factors, operators of larger farms are also confronted with the problem of finding suitable labor. The supply of labor may often be the factor that determines the organization of a farm.

Cotton farms. The average farm of this size-type group had 115 acres of total farm land. Approximately 71 acres of this was cropland and 28 was in pasture; of the latter, 4 acres was woodland. These farms derived a large proportion of their incomes from cotton, keeping very few productive livestock. The average farm had about 22 acres of cotton, of which 6 acres were farmed by the tenant family. The total net income accruing to the operator and his family after deduction of all farm expenses including the cost of tenant labor was $933; and the family labor earnings were $689. See tables 37 and 38.

Livestock-cotton farms. The average farm in this group derived over 50 percent of its gross income from livestock enterprises. Dairying was by far the most important single enterprise on the farms. On the average, 25 percent of the gross income was from the sale of milk to local processing plants.

The average farm had 140 acres of total land. Of this, 63 acres were in cropland and 68 acres were in pasture; of the latter, 27 acres were woods pasture. The farm operator and his family maintained nine milk cows. There were 14 acres of cotton on the farm, about one-half of which was worked by the tenant family. The total net income accruing to the operator and his family after deducting all farm expenses including the cost of tenant labor was $1,178, and the family labor earnings were $866. See table 38.

Returns Per Man-Day of Labor on the Two Types of Farms

The net cash returns per man-day of work was $1.37 on the livestock-cotton farm as compared to $1.03 on the cotton farm. See table 39. This includes the labor of both the operator and the tenant families, and thus affords some measure of over-all efficiency of the two representative farms. The total days of employment and its distribution between the operator and the tenants also affect the net returns finally accruing to the farm operator.

Annual Employment and Incomes Per Man-Equivalent Worker in Operator's Family on the Two Types of Farms

As was found on the one-family size farms, the incomes per worker were higher on the farms which provided the highest number of days employment

Table 37. Two-family size farms: land use, cropland and livestock organizations by types of farms, Northeast Prairie Area, 1942

Item	Types of farms[1]	
	Cotton	Livestock-cotton
Acres in farms	115.0	140.0
Cropland	71.1	63.0
Open pasture	24.3	41.7
Woods pasture	3.7	26.5
Woods not pastured	4.0	3.8
Other land	11.9	5.0
Cropland acres in		
Cotton	21.9	14.4
Corn	19.4	17.0
Oats	0.0	0.8
Peas (seed)	3.6	0.8
Beans (seed)	0.0	0.5
Johnson grass hay	7.9	12.2
Other hay	10.2	14.7
Sorghum silage	0.0	0.0
Peanuts (nuts)	0.7	0.1
Garden and truck	1.8	1.8
Idle cropland	5.3	1.8
Other cropland	0.8	0.1
Livestock numbers		
Workstock	4.0	4.0
Milk cows	3.0	9.0
Beef cows	0.0	0.0
Steers	0.0	1.0
Sows	1.0	2.0
Meat hogs	3.0	3.0
Chickens	38.0	52.0

[1] The cotton farm is based on an average of 9 farms; the livestock-cotton farm on an average of 14 farms, of which 7 were originally classed as cotton-dairy farms.

Source: Sample farms in Prairie Study.

Table 38. Two-family size farms: farm investments, normalized farm incomes, and farm expenses by types of farms, Northeast Prairie Area, 1942[1]

Item	Types of farms	
	Cotton	Livestock-cotton
Farm investment		
Land and building	$3,913	$4,795
Livestock and equipment	963	1,450
Total	4,876	6,245
Cash income		
Crop receipts	1,237	774
Livestock receipts	297	1,164
Other cash receipts[2]	3	4
Gross cash income	1,537	1,942
Noncash income[3]	297	368
Total gross income	1,834	2,310
Expenses		
Cash-farm	697	916
Noncash farm[4]	204	216
Total	901	1,132
Net cash income (Gross cash income less cash expenses)	840	1,026
Total net income (Total income less total expenses)	933	1,178
Interest on investment (5 percent)	244	312
Family labor earnings (Total net income less Interest on investment	689	866

[1] Incomes and expenses calculated by applying 5-year average prices, 1939-1943, to the 1942 farm sales and purchases. See Appendix tables 2, 3, and 4.

[2] Rents from workstock, pasture, or equipment.

[3] Value of farm-grown products used by operator's family; does not include value of farm-grown products consumed by the tenant families.

[4] Depreciation charges on buildings, workstock, and machinery. The rates charged are shown in Appendix table 5.

Table 39. Two-family size farms: returns per man-day of labor for entire labor force by types of farms, Northeast Prairie Area, 1942[1]

Farm type	Income per man-day of work		
	Gross cash	Net cash	Net cash above interest on investment
Cotton	$3.03	$1.51	$1.03
Livestock-cotton	3.98	2.00	1.37

[1] Income calculations based on 5-year average farm prices, 1939-1943; days of work calculated by applying average labor requirements, as shown in Appendix table 1, to crops and livestock on the farms.

per year. On the average cotton farm the volume of enterprises carried on by the operator's family was such as to require 182 days of work per worker, or 91 percent of the estimated days suited for field work. The labor earnings were $312 per man-equivalent worker in the operator's family. On the average livestock-cotton farm the volume of enterprises carried on by the operator's family was such as to require 208 days of work per worker, or 4 percent above the estimated suitable working days. The labor earnings were $456 per man-equivalent worker in the operator's family. See table 40. The operators of both types of farms were required to hire some day labor. Because of the extreme seasonal variations in labor reqirements for cotton, the operator of the cotton farm was obliged to hire more labor than the operator of the livestock-cotton farm. Thus, the total days of employment per worker

Table 40. **Two-family size farms: man-equivalent workers in operator's family; days of employment, cotton acres, cattle numbers, and farm income per man-equivalent worker in operator's family; and cotton acres worked by tenants, by types of farms, Northeast Prairie Area, 1942**[1]

Farm type	Number of man-equivalent workers[2]	Per man-equivalent worker							
		Days of employment	Cattle numbers		Acres of cotton	Gross cash income	Net cash income	Total net income	Labor earnings
			For milk	Beef including steers					
Cotton	2.2	182	1.4	0.0	7.2	$ 696	$380	$422	$312
Livestock-cotton	1.9	208	4.6	0.8	4.0	1,022	540	620	456

[1] Income figures calculated from table 23, based on 5-year average farm prices.

[2] Man-equivalent worker calculated as follows: males, 18 years or older = 1; 10 to 18 years = 0.6; females, 10 years or older = 0.3.

in the operator's family was considerably higher on the livestock-cotton than on the cotton farm. This, along with the higher rates earned per day, accounts for the labor earnings being about 46 percent higher on this farm than on the cotton farm. See table 40.

These comparisons indicate that on the average there is a distinct advantage to including a relatively large livestock enterprise in the organization of a two-family size farm with emphasis on dairy production. By so doing, a given labor force is enabled to handle a larger volume of production and to find employment for more days in the year. The fact should not be overlooked, however, that the livestock type of farming requires a larger farm and a higher farm investment than is needed for cotton farming.

Multiple-Family Size Farms

It was found on the one- and two-family size farms that the incomes to the operators' families were greatly influenced by the volume of production and days of employment of the operators' families on their farms. These are important considerations on the larger farms also. As the size of the farm increases, however, the proportion of the total farm operations that can be carried on by the operator's family becomes less, and the employment of the operator's family comes to be of less relative importance. On the larger farms, consideration should first be given to maximizing a production of the farm as a whole; secondly, the operator should carry on as large a volume of production with his own family as possible without interfering with his management of the over-all farm activities.

Many of the farms included in the multiple-family group have from 5 to 10 tenant families under the operator. With a farm of this size, it is often an advantage to the operator, as well as to the tenants, for the tenants to farm all of the row crops and for the operator to devote his time to directing farm activities and looking after workstock, equipment, and a limited number of productive livestock.

Cotton farms. The average size farm in this group had four tenant families and 230 acres of farm land. Of this acreage 176 was in cropland and 40 was in pasture. The farm had about 47 acres in cotton, 38 of which was farmed by the tenants. Very few livestock were kept for commercial purposes. The net cash income accruing to the operator and his family after paying all cash costs, including payments to tenants was $1,088. The total net income, which is the total of cash receipts and the value of home-grown products used by the family less all farm expenses, was $911. After deduction of 5 percent interest on farm investment, the operator and his family had only $392 as returns to the family for labor and management. See tables 41 and 42.

Cotton-livestock farms. The average farm of this group had 273 acres of farm land, of which 139 acres was in cropland and about 104 acres in pasture. Of the latter, 21 acres was woods pasture. Although larger in total acres than the cotton farm, this farm had less acres in cropland, and had only three tenant families as compared with four on the cotton farm. As indicated by the large pasture acreage, the operator of this farm usually kept about nine milk cows and raised two or three steers for market each year. The farm derived approximately one-third of its gross income from the livestock enterprises. The farm had about 35.5 acres in cotton, 25 of which was worked by tenants. The net cash income accruing to the operator and his family was $1,187. The total net income was $1,140, of which $598 was family labor and management earnings.

Livestock-cotton farms. The average farm in this group received about 64 percent of its gross income from livestock. It had large cash enterprises of dairying and beef cattle production. It had 509 acres of farm land, of which approximately 218 was cropland and 250 was open pasture. Only 38 acres of the cropland was in cotton and 30 of this was worked by the three tenant families. The operator of the farm usually kept 26 dairy cows and raised about 23 steers. With these numbers of livestock the operator evidently had to hire most of the work done in milking the cows and in growing and harvesting feed crops. The average operator and his family received $2,056 of net cash income from the farm. The total net farm income was $1,555. With the large number of cattle kept, a high farm investment was required. After paying all farm costs and deducting 5 percent interest on the farm investment, the operator and his family received only $359 for labor and management.

Beef cattle-cotton farms. The average farm of this type was much larger than the multiple-family size farms which were engaged chiefly in cotton and dairy production. The farm derived approximately 54 percent of its gross

Table 41. Multiple-family farms: land use, and cropland and livestock organizations, by types of farms, Northeast Prairie Area, 1942

Item	Types of farms[1]			
	Cotton	Cotton-livestock	Livestock-cotton	Beef cattle-cotton
Acres in farm	230.0	273.0	509.0	1136.0
Cropland	176.0	139.0	217.9	416.4
Open pasture	36.1	83.5	249.3	501.8
Woods pasture	4.3	20.7	6.3	99.0
Woods not pastured	4.4	9.1	14.1	100.0
Other land	9.2	20.7	21.4	95.4
Cropland acres in				
Cotton	47.3	35.5	37.8	127.8
Corn	70.1	48.8	53.4	53.7
Oats (grain)	0.0	0.0	24.5	53.3
Peas (seed)	0.5	0.9	0.0	19.2
Beans (seed)	0.8	0.0	0.0	8.0
Johnson grass hay	33.1	12.6	104.0	59.6
Other hay	20.9	26.3	17.5	78.0
Sorghum silage	0.0	0.5	1.7	24.0
Peanuts (nuts)	0.7	0.7	0.5	0.5
Garden and truck	1.4	4.9	4.3	10.1
Idle cropland	2.3	6.7	2.4	1.4
Other cropland	0.0	3.7	0.0	0.0
Livestock numbers				
Workstock	7.0	7.0	17.0	16.0
Milk cows	5.0	9.0	26.0	4.0
Beef cows	0.0	1.0	0.0	16.0
Steers	0.0	2.0	23.0	173.0
Sows	1.0	3.0	5.0	1.0
Meat hogs	3.0	4.0	2.0	2.0
Chickens	30.0	80.0	50.0	35.0

[1] The cotton farm is based on an average of 11 farms; the cotton-livestock on an average of 8 farms; the livestock-cotton on an average of 4 farms; and the beef cattle-cotton on an average of 5 farms.

Table 42. Multiple-family farms: farm investments, normalized farm incomes, and farm expenses by types of farms, Northeast Prairie Area, 1942[1]

Item	Types of farms			
	Cotton	Cotton-livestock	Livestock-cotton	Beef cattle-cotton
Farm investment				
Land and buildings	$ 8,783	$ 8,381	$18,815	$37,530
Livestock and equipment	1,594	2,453	5,114	10,929
Total investment	10,377	10,834	23,929	48,459
Cash farm income				
Crop receipts	2,944	1,918	1,792	8,385
Livestock receipts	279	1,139	3,664	10,521
Other cash receipts[2]	0	0	10	0
Gross cash income	3,223	3,057	5,466	18,906
Noncash income[3]	265	400	242	406
Total gross income	3,488	3,457	5,708	19,312
Expenses				
Cash farm	2,135	1,870	3,410	14,341
Noncash farm[4]	382	448	743	1,572
Total	2,577	2,317	4,153	15,912
Net cash income (Gross cash income less cash expenses)	1,088	1,187	2,056	4,565
Total net income (Total gross income less total expenses)	911	1,140	1,555	3,400
Interest on investment (5 percent)	519	542	1,196	2,423
Family labor earnings (Total net incomes less interest on investment)	392	598	359	977

[1] Incomes and expenses calculated by applying 5-year average prices, 1939-1943, to the 1942 farm sales and purchases. See prices in Appendix tables 2 and 3.

[2] Rents from workstock, pasture, or equipment.

[3] Value of farm-grown products used by the operator's family; does not include value of farm grown products consumed by tenant families.

[4] Depreciation charges on buildings, workstock, and machinery. Rates charged are shown in Appendix table 5.

income from livestock. The greater part of this was from the sale of beef cattle. The average farm of this class had 1,136 acres of farm land. It had approximately 416 acres in cropland and 600 acres in pasture, of which 100 acres was woods pasture. It averaged 128 acres in cotton, 123 acres of which was farmed by tenant families, generally from 10 to 12 in number. The operator kept some 20 cows, mostly of beef breeds, and usually fed out and sold about 175 steers. The net cash income from the farm was $4,565. After deduction of depreciation charges on improvements, machinery, and workstock, and adding the value of farm-grown products used by the family, the total net income to the operator and his family was $3,400. With the large numbers of cattle kept, a high farm investment was required. When 5 percent interest on investment was deducted from total net income, there remained $977 as family labor and management earnings.

Returns Per Man-Day of Work by Types of Farms

The net cash returns per man-day of work were highest on the beef cattle-cotton farm, and were second to highest on the cotton farm. The cotton-livestock and livestock-cotton farms fell in third and fourth places, respectively, on net cash returns per day of work. See table 43. The gross cash and the net cash returns per day of work were much higher on the beef cattle-cotton farms than on the cotton farms. After deduction of 5 percent interest on investment, however, the returns per day of work were slightly higher on the cotton farms. This is because of the extremely high investment on the beef cattle-cotton farms. The returns per day of work is an important consideration in the efficiency of the farm business, but it is not necessarily true that the highest returns per day will insure the highest returns for the year to a given labor force.

Returns Per Acre of Farm Land by Type of Farm

On a per acre basis, the cotton-livestock farm returned the highest net income and the highest labor earnings to the operator's family. See table 44. On this farm the operator kept nine milk cows, about the number the family could care for without hiring additional labor. Aside from this family-size dairy enterprise, the operator devoted his chief interest to the growing of cotton with tenant labor. The second highest net returns per acre were produced by the cotton farm, the farm that produced the highest net returns per day of work. Falling in third and fourth places on net returns per acre were the beef cattle-cotton and the livestock-cotton farm, respectively. This is to be expected since these two farms have two to four times as much land as the cotton and cotton-livestock farms and practice a more extensive type of farming.

Income Per Man-Equivalent Workers in Operator's Family

Family labor earnings were $123 per man-equivalent worker on the cotton farm, $203 on the livestock-cotton farm, $285 on the cotton-livestock farm, and $567 on the beef cattle-cotton farm. Apart from cropper enterprises, there were 106 man days of productive work performed on the cotton farm per man-equivalent in the operator's family, 270 on the cotton-livestock farm, 548 on the livestock-cotton farm, and 546 on the beef cattle-cotton farm. See table 45. It is evident that the beef cattle-cotton farm and livestock-cotton

Table 43. Multiple-family farms: returns per man-day of labor for entire labor force by types of farms, Northeast Prairie Area, 1942[1]

Farm type	Gross cash	Net cash	Net cash above interest on investment
Cotton	$3.16	$1.80	$1.30
Cotton-livestock	3.03	1.37	.83
Livestock-cotton	3.64	1.30	.52
Beef cattle-cotton	6.69	2.17	1.28

[1] Income calculations based on farm incomes shown in table 42; labor requirements based on farm organizations shown in table 41; using average requirements per enterprise for the area.

Table 44. Multiple-family farms: returns per acre of farm land accruing to the operator and his family, by types of farms, Northeast Prairie Area, 1942

Farm type	Returns per acre of farm land			
	Gross cash income	Net cash income	Total net income	Family labor earnings
Cotton	$14.01	$4.39	$3.96	$1.70
Cotton-livestock	11.20	4.35	4.18	2.19
Livestock-cotton	10.74	4.04	3.06	.71
Beef cattle-cotton	17.00	4.02	2.99	.86

farm hired more labor than the two smaller farms and that the amount of labor hired had some effect on income per man-equivalent in the operator's family.

Proper Balance Between Cotton and Livestock Enterprises is Keynote to Best Paying Organization for Multiple-Family Farms

Under average conditions, there seems to be a distinct advantage in including a livestock enterprise of considerable importance in the organization of multiple-family farms. The inclusion of a livestock enterprise or enterprises in the organization of the farm more nearly provides year-round employment for the labor force, and while the returns per acre or per day of labor is lower for livestock enterprises than for cotton, the increases in the number of acres utilized or the days worked increases the farm income.

Other Factors Affecting Profits

In addition to the type of farming practiced, several other factors, such as size of farm, grade of soil, and tenure of operator were found to affect profits.

Size of Business

Farm management studies have consistently shown that in normal times large farms pay better than small farms and that extremely small farms (taking into account the type of farming) no matter how efficiently organized, cannot be made to produce income sufficient for a satisfactory standard of living. Farms in this area fall into the same general pattern. That is, in each instance as the size of farm increased, the family labor earnings increased. See table 46. Family labor earnings on the smallest group of farms, those having from 20 to 50 acres of cropland and open pasture, averaged $424 of which about $300 was the value of home-used products. In other words on an average this group of farmers only had about $200 cash (including the 5 percent interest on investment that was charged for use of capital) to spend for food, clothing, medicine, and recreation, after all expenses including normal de-

Table 45. Multiple-family farms: man-equivalent workers in operator's family and days of employment, cotton acres, cattle numbers, and farm income per man-equivalent worker in operator's family, by types of farms, Northeast Prairie Area, 1942[1]

		Per man-equivalent worker							
Farm type	Man-equivalent worker[2]	Days of employment[3]	No. of milk cows	No. of beef cows and steers	Acres of cotton	Gross cash income	Net cash income	Total net income	Labor earnings
Cotton	3.2	106	1.6	0.0	2.9	$1,001	$340	$285	$123
Cotton-livestock	2.1	270	4.3	1.9	5.1	1,456	565	543	285
Livestock-cotton	1.8	548	14.7	10.1	4.5	3,088	1,162	879	203
Beef cattle-cotton	1.7	546	2.3	104.0	2.8	10,920	2,654	1,976	567

[1] Income figures calculated from table 27; based on 5-year average farm prices.

[2] Man-equivalent worker calculated as follows: males, 18 years or older = 1; 10 to 18 = 0.6; females, 10 years or older = 0.3.

[3] Does not include time operator spends in supervising the farm activities, but does include all work on enterprises carried on by the operator and his family, including hired day labor.

preciation and repairs had been met. This is clearly inadequate, and it seems that the average farmer in this area should have at least 50 acres of cropland and open pasture in order to produce income sufficient for a minimum standard of living, and a larger acreage for a fair standard of living.[8]

Soils

Because size of farm has such an important effect on profits, the effect of soils on profits was studied separately for each of the size groups shown in table 47. When this was done, it was found that in each size group the farms having A or B grade soil made higher family labor earnings than the

Table 46. Relation of size of business as measured by acres of cropland and open pasture[1] to profits, 32 farms, Black Prairie, 1942

Acres of cropland and open pasture	Number of farms	Average per farm	
		Cropland and open pasture	Family labor earnings
		acres	dollars
20 to 50	19	34	424
50 to 80	23	65	683
80 to 120	18	97	781
120 to 200	15	160	890
200 and above	17	620	1223

[1] Five acres of woodland pasture were counted as one acre of open pasture.
Source: Sample farms of the Prairie Study.

Table 47. Relation of soil[1] to profits, by size of farm,[2] 92 farms, Black Prairie, 1942

Size and grade of soil	Number of farms	Average per farm	
		Cropland and open pasture	Family labor earnings
		acres	dollars
20 to 50 acres			
A and B soils	12	34	489
C soil	7	34	312
50 to 80 acres			
A and B soils	20	65	697
C soil	3	64	591
80 to 120 acres			
A and B soils	12	99	845
C soil	6	93	654
120 to 200 acres			
A and B soils	9	162	1,124
C soil	6	157	537
200 acres and above			
A and B soils	14	612	1,913
C soil	3	657	—2,001

[1] For the purposes of this table soils were grouped broadly into two classes, A and B soils and C soil. A and B soils were grouped into one class because a more detailed study of the various soils such as often exist on each farm would be needed to discriminate between them. Considering soil types and their characteristics and the proportions of each, soil depletion and erosion, and other evidences of soil productivity, the poorer soils were classed C, without strict reference to soil type.

[2] Acres of cropland and open pasture. Five acres of woodland pasture were counted as one acre of open pasture.

Source: Farm operators in the Prairie Study.

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[8] In this chapter the acres of cropland plus plowable pasture plus one-fifth of woodland pastures, was taken as the physical measure of size.

farms having C grade soils. It is important to point out that while profits increased in each instance as the size of farm having A and B grade soils increased, the profits decreased on farms having C grade soil after they reached medium size.

Tenure of Operator

There was no consistent relationship between tenure and profits for the farms studied. That is, tenants produced higher incomes than owners on farms having less than 80 acres of cropland and open pasture and lower incomes than owners on farms having from 80 to 200 acres of cropland and open pasture. See table 48. These figures, as far as financial returns are concerned, would seem to indicate that it would pay farmers with limited funds to rent farms and use what capital they have for productive purposes rather than sink all their funds in a small farm and attempt to operate it with insufficient working capital. However, factors other than financial returns should be and are taken into account when farm operators purchase farms. Security, stability, the satisfaction of owning one's own home and a higher status in the community, are factors that cannot be ignored when contemplating purchasing as contrasted with renting a farm. It is well known that tenants as a rule do not feel justified in practicing soil-conserving and soil-building methods, such as owners can economically practice.

Comparison of Farms with High and Low Profits[9]

In order to check the results obtained when the farms were studied by the type of farming followed, the farms were divided into the five size groups shown in table 49, and the most profitable and least profitable farms in each

Table 48. Relation of tenure[1] to profits, by size of farm,[2] 92 farms, Black Prairie, 1942

Size and tenure of operator	Number of farms	Average per farm: Cropland and open pasture	Average per farm: Family labor earnings
		acres	dollars
20 to 50 acres:			
Tenants	6	35	511
Owners	13	34	383
50 to 80 acres:			
Tenants	4	68	1,185
Owners	19	66	577
80 to 120 acres:			
Tenants	4	86	709
Owners	14	100	802
120 to 200 acres:			
Tenants	5	149	689
Owners	10	166	960
All farms (20 to 200 acres)[3]			
Tenants	19	81	741
Owners	56	85	656

[1] Part-owners were classified as owners.

[2] Acres of cropland and open pasture. Five acres of woodland pasture were counted as one acre of open pasture.

[3] There was only one tenant in the group of 17 farms having over 200 acres of cropland and open pasture.

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[9] In this chapter, in calculation of income from production livestock, a balance was struck between inventories at the beginning of the year plus purchases and final inventories plus sales. Beyond this, it was not possible to allocate expenses among enterprises.

group were studied to determine if the high income farms were giving livestock a more important place in the organization of their farms than the low income farms. It was found that in each size group the high income farms received a higher percentage of their gross farm income from livestock and livestock products than the average for all farms, and that the low income farms in each size groups received a smaller percentage of their gross from income from livestock and livestock products than the average for all farms. See table 51. The data presented in this table substantiates the conclusion arrived at in the study of types of farming, that farmers who include livestock enterprises of considerable importance in the organization of their farms make more profits than farmers who give livestock a place of minor importance in the farm organization.

SUMMARY AND CONCLUSIONS

Farm operating units are larger in the Prairie Area than in other types-of-farming areas of the State except Brown Loam and Delta Areas. A sample of AAA worksheets in Clay, Lee, and Monroe Counties show that 48 percent of the farms are one-family size units; 16 percent are two-family size units; and 36 percent are multiple-family units. On an acreage basis, 49 percent of the farm operating units have 40 acres of cropland or less; 77 percent have 100 acres or less; and only 9 percent have over 300 acres. As an indication, however, of the concentration of cropland in relatively large operating units, 5 percent of the operating units included 48.2 percent of all cropland.

In 1942 approximately 19 percent of the AAA farm operators were tenants. About two-thirds of these tenant operators paid share rent, and the other one-third paid cash or standing rent. The prevailing type of lease was the 1 year oral lease. Approximately 86 percent of the tenant operators' leases were oral agreements, and of those having written leases, the majority were rehabilitation clients of the Farm Security Administration.

Of the total land in farms in the Area, the AAA classified about one-half as cropland and one-third as open pasture. Some 13 percent of the farm land was in woods, most of which was pastured. Of the total cropland on the sample farms studied, approximately 28 percent was in cotton, 27 percent

Table 49. Comparison of family labor earnings and proportion of gross income from livestock and livestock products in high and low income farms, by size of farm,[1] 92 farms, Black Prairie, 1942

Size	High income farms[2]		Low income farms[3]		All farms	
	Percent of gross-income from livestock and livestock products	Average family labor earnings	Percent of gross-income from livestock and livestock products	Average family labor earnings	Percent of gross-income from livestock and livestock products	Average family labor earnings
25 to 50	41	$ 615	33	$ 268	37	$ 424
50 to 80	61	1,102	34	279	38	683
80 to 120	51	1,145	36	415	43	781
120 to 200	56	1,455	24	370	44	890
200 and above	47	4,189	36	—1,081	39	1,223

[1] Acres of cropland and open pasture. Five acres of woodland pasture were counted as one acre of open pasture.

[2] The upper third of farms in each size group based on family labor earnings.

[3] The lower third of farms in each size group based on family labor earnings.

in corn, and 34 percent in hay crops. Over half of the acreage in hay was in Johnson grass, which is a volunteer growth.

The use of commercial fertilizer was very low. Only 48 percent of operators reported using commercial fertilizer on 37 percent of cotton acreage in 1942; 8 percent reported using fertilizer on 2 percent of corn acreage. A comparison of fertilizer practices with recommendations of the Experiment Station indicates that yields of major crops could be increased materially through the usage of increased quantities of fertilizer.

Crop yields are not high in the Prairie and they fluctuate widely from year to year due in large measure to variation in rainfall. Records of the State AAA office show that the over-all average cotton yields for Clay, Lee, and Monroe Counties varied from 139 pounds in 1939 to 325 pounds in 1942, and averaged 219 pounds per acre for the 5-year period, 1938-1942. The average corn yields for the sample farms studied were 19 bushels per acre in the good crop year, 1942.

Feeding rates for livestock were too low on most farms in the Prairie to insure best returns from livestock. According to feeding standards recommended by livestock specialists, the Prairie farms are only slightly deficient in corn and grain feeds, but very deficient in roughages, both hays and pasture. One-family size farms, on the average, fed only 63 percent of the hay recommended by specialists and available pasture acreage was only 75 percent of that recommended. If proper practices were followed on the pasture acreages, however, the desired grazing could probably be obtained for the 1942 numbers of livestock without increasing the total acreage.

The quantity of cottonseed meal fed to cattle was below that recommended, except on farms having commercial dairy enterprises. On the latter, the quantity of cottonseed meal fed was far in excess of that recommended, yet the quantities of roughage fed were very deficient. Obviously, more roughage feed could be substituted for concentrates with distinct economic advantages on these farms.

A large proportion of farm operators within the area depend on credit either for the purchase of farms or for operating capital or both. Of the sample farms studied, 53 percent used short term credit for furnish and crop production in 1942. Of the owner-operated farms studied, 56 percent had an outstanding mortgage.

The highest incomes were made on farms which derived a large proportion of their gross income from livestock and livestock products. Annual incomes varied directly with the days of employment provided and the extent to which the labor force was given year-round employment. The return per acre or per day of labor was lower for livestock enterprises than for cotton, but the increase in the number of acres utilized and days worked increased the farm income over what it was when livestock enterprises were neglected or given a place of minor importance in the farm organization. The smaller farmers found it profitable to give dairying a prominent place in the organization of their farms whereas the larger farms tended more toward general livestock farming.

In addition to the type of farming practiced, profits varied with size of farm, quality of soil, color and tenure of operators. Quality of soil was a very important factor in the determination of profits as well as physical yields. Profits consistently increased with size of operating units. Also white farmers as a group made slightly higher profits than did negro operators, which was due in some measure to differences in soil fertility. Tenants in general had higher profits than owners of the smaller farms, and lower profits than did owners of the larger farms.

Appendix

Table 1. Man labor and power used per acre of crops and per unit of livestock, Northeast Prairie Area, 1942[1]

Item	Total hours			Distribution of man hours by months											
	Man	Mule	Tra.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Crops: Mule equipment															
Cotton	118.0	48.0	----	1.8	1.8	1.2	6.5	22.2	18.8	14.0	5.4	24.2	18.8	2.7	.6
Corn	43.0	47.0	----	1.0	1.6	3.7	7.7	11.3	7.0	1.0	----		5.2	3.5	1.0
Bean and pea hay	25.0	32.0	----	----	----		3.2	3.0	1.0		7.5	7.5	1.2	1.0	.6
Peanuts	66.0	36.0	----	----	----	7.5	7.5	8.0	6.4	1.6		25.0		10.0	----
Peas (seed)	29.0	30.0	----	----	1.0	3.0	5.0	6.0	2.0	1.0	8.0	3.0		----	—
Sweetpotatoes	112.0	52.0	----	----	—	8.5	18.5	24.4	8.6			9.5	42.5		—
Sorghum syrup	138.0	72.0	----	----	----	5.0	3.4	6.0	8.5	7.1	----	54.0	54.0	----	—
Gardens	124.0	36.0	----	2.0	2.0	17.5	22.5	18.5	18.0	12.5	10.0	10.0	10.0	1.0	—
Horse and tractor equipment															
Soybean hay	18.0	16.0	2.0	—	—	----	2.2	1.8	.6		7.0	5.2		.6	.6
Lespedeza hay	10.8	13.0	.8	----	1.0	1.0			.6	--	4.8	3.4	----	----	—
Johnson grass hay	18.5	16.0	1.1	----	----			.6	8.0	5.5	1.2	1.8	1.4		---
Alfalfa hay	37.2	22.0	7.8	----	----			6.0	9.5	8.6	3.7	9.4	----		—
Sorghum silage	49.2	23.4	4.4	--	----	.5	2.9	2.4	3.6	1.0	8.3	10.7	16.8	---	—
Livestock (per head)[2]															
Workstock	54.0			4.8	4.8	4.8	5.2	5.2	4.9	4.0	4.0	3.9	4.1	4.1	4.2
Dairy cows	144.0	----	---	12.6	12.6	12.2	12.2	12.2	11.8	11.0	11.0	11.2	12.0	12.6	12.6
Beef cows	23.0			2.8	2.8	2.4	1.6	1.4	1.2	1.2	1.2	1.6	1.8	2.2	2.8
Sows and gilts	50.0			4.0	4.0	4.4	4.6	4.6	4.0	3.8	3.8	3.8	4.2	4.4	4.4
Ewes	5.4	--	--	1.0	1.0	.6	.2	.2	.2	.2	.2	.2	.2	.4	1.0
Chickens (50 hen flock)	260.0	--		18.0	19.0	22.0	32.0	35.0	32.0	20.0	16.0	16.0	16.0	16.0	18.0

[1] Data from 180 practice sheets obtained in Prairie Areas of Clay, Lee, and Monroe Counties.

[2] Includes labor required for young animals and replacement stock kept.

Table 2. Prices used in calculating normalized farm incomes, based on average prices received in 5-year period, 1939-43, Northeast Prairie Area[1]

Item	Unit	5-year average price	Price interpolations used[2]
Cotton lint	lb.	$ .145	
Cottonseed	ton	36.00	
Corn	bu.	.90	
Oats	bu.	.59	
Hay, all	ton	---	1942 prices as listed
Soybeans (beans)	bu.	1.80	
Cowpeas (peas)	bu.	1.60	
Sweetpotatoes	bu.	1.00	
Irish potatoes	bu.	1.20	
Truck crops	---	..	1942 prices as listed
Milk, whole	cwt.	1.92 (4.5 percent butterfat)	85 percent of 1942 prices
Eggs	doz.	.23	1942 prices as listed
Beef cattle	cwt.	6.72	82.2 percent of 1942 prices
Milk cows	head	50.00	86 percent of 1942 prices
Hogs	cwt.	8.85	76.5 percent of 1942 prices
Chickens	lb.	.18	80 percent of 1942 prices
Turkeys	lb.	.20	1942 prices as listed
Workstock	head		97 percent of 1942 prices

[1] Average prices obtained from Agricultural Marketing Service for the crop reporting districts 3 and 6.

[2] Interpolated prices, on the average, equal the 5-year average prices.

Table 3. Prices used in determining cash farm expenses, based on average prices paid in 5-year period, 1939-43, Northeast Prairie Area[1]

Item	Unit	5-year average prices	Price interpolations used[2]
Feeds bought:			
Hay, all	ton	-----	95 percent of 1942 prices
Cottonseed meal	ton	$36.00	84 percent of 1942 prices
Cottonseed hulls	ton	......	84 percent of 1942 prices
Dairy feed (16 pct. protein)	cwt.	2.11	91 percent of 1942 prices
Corn	bu.	.90	95 percent of 1942 prices
Oats	bu.	.65	89 percent of 1942 prices
Bran (wheat)	cwt.	1.81	84 percent of 1942 prices
Laying mash	cwt.	2.83	85 percent of 1942 prices
Fertilizer bought:			
4-8-4	ton	27.00	92 percent of 1942 prices
Nitrate of soda	ton	38.31	92 percent of 1942 prices
Acid phosphate	ton	20.65	94 percent of 1942 prices
Muriate of potash (50 pct.)	ton	41.55	88 percent of 1942 prices
All others	...	......	92 percent of 1942 prices
Hired labor	day	1.29	94 percent of 1942 prices
Livestock purchased:			
Milk cows	head	.	86 percent of 1942 prices
Beef cattle	head	.	82 percent of 1942 prices
Hogs	head		76.5 percent of 1942 prices
Workstock	head	...	97 percent of 1942 prices
Seed bought:			
Beans and peas	bu.	...	87 percent of 1942 prices
Winter legume	lb.	....	The 1942 prices as listed
Cottonseed	acre	..	$1.00 per acre
Ginning	bale	...	The 1942 prices as listed
Milk hauling	cwt.	Approximately 25c	The 1942 prices as listed
Machinery repairs	----	...	The 1942 prices as listed
Building repairs	----	......	2 percent of present value

[1] Average prices obtained from Agricultural Marketing Service for the crop reporting districts 3 and 6.

[2] Interpolated prices, on the average, equal the 5-year average price.

Table 4. Values placed on home-used products in determining normalized farm incomes, Northeast Prairie Area, 1942

Item	Unit	Price	Item	Unit	Price
Milk (whole)	gal	$ .20	Sweetpotatoes	bu.	$1.00
Eggs	doz.	.23	Sirup	gal.	.50
Chickens	head	.50	Canned vegetables and fruits	qt.	.15
Pork	lb. live wt.	.0885	Wood	cord	3.00
Beef	lb. live wt.	.0672			
Irish potatoes	bu.	1.20			

Table 5. Calculated charges made against farm incomes for depreciation and for operational costs of cars and trucks used in farm business, Northeast Prairie Area, 1942

Item	Depreciation	Operational expenses
Buildings	2% of new value	
Equipment:		
All horse drawn	10% of new value	
Tractors	12½% of new value	Actual as estimated by farmers
Tractor cult. equip.	12½% of new value	
Tractor haying equip.	25% of new value	
Automobiles	2c per mile farm use	2c per mile farm use
Trucks, ½ ton	3c per mile farm use	3c per mile farm use
Trucks, other	4c per mile farm use	4c per mile farm use
Workstock	$10 per head	

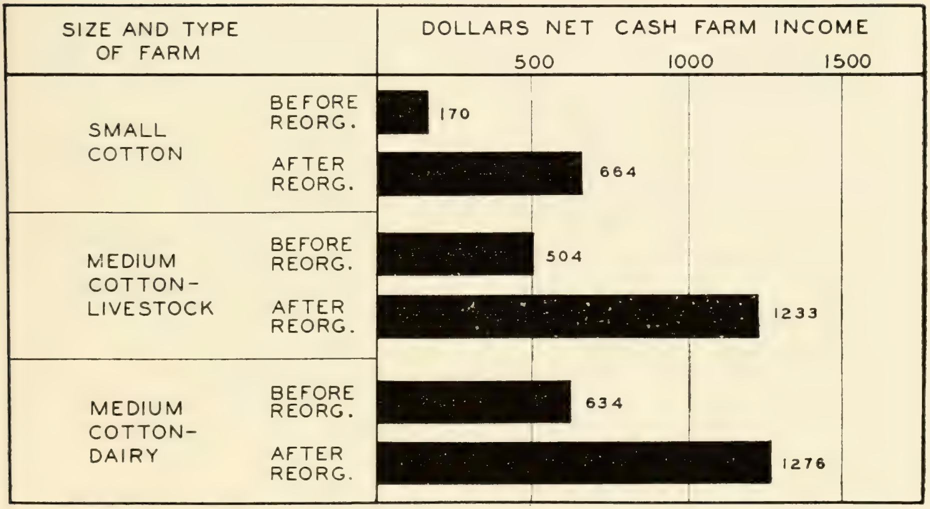
BULLETIN 405 JUNE 1944

Farm Organization and Adjustment Problems

IN THE

Shortleaf Pine Area

OF MISSISSIPPI



Net cash farm income before and after reorganizing three representative farms in the Shortleaf Pine type-of-farming Area (assumes 1937-41 average prices)

In Cooperation With

THE BUREAU OF AGRICULTURAL ECONOMICS
U. S. DEPARTMENT OF AGRICULTURE

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

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FARM ORGANIZATION AND ADJUSTMENT PROBLEMS IN THE SHORTLEAF PINE AREA, MISSISSIPPI

By ELBRIDGE A. TUCKER, FRANK J. WELCH
and JAMES C. DOWNING[1]

The need for agricultural adjustments in the Shortleaf Pine Area stems largely from the fact that returns to farm families are much too low. Relative returns after the war may be much lower unless adjustments are made in the size of farms, number of farm workers, crop and livestock systems, and production practices. Excessive soil erosion and the unfavorable outlook for cotton emphasize the need for wide-spread adjustments.

The purpose of this study is to provide information about farming in the Shortleaf Pine Area that will aid policy makers, agricultural technicians, and farmers in their efforts to improve the status of farm families residing in the Area. Information concerning farm income and the conservation of resources will be stressed. Specific objectives include the following:

(1) To provide a general description of the area and its resources.

(2) To describe the kinds of farms in the Area and show their distribution according to important size and type groups. Farm problems can be effectively attacked through studying adjustments needed on farms of different sizes and types.

(3) To indicate the kind and extent of changes that should be made in the organization of individual farms representing important size and type groups.

(4) To indicate the extent to which farm incomes could be raised through farm reorganization as in (3) above, and through the adoption of recommended production practices.

(5) To indicate the nature, direction, and extent of desirable post-war agricultural adjustments for the Area as a whole.

(6) To discuss ways in which obstacles to agricultural adjustment could be overcome.

Collection and Preparation of Data

Data concerning land use and livestock numbers were tabulated from a 20-percent sample of the 1941 AAA worksheets from four sample counties of the Area—Leake, Calhoun, Union, and Winston—as an aid in describing the agriculture of the Shortleaf Pine Area and for use as a basis for selecting representative farms from which more detailed information concerning individual farm businesses might be obtained. The AAA records were classified into groups of farms with similar resources and organization. Detailed farm organization data were obtained by the survey method from 208 farms selected at random from the major size-type groups of farms. Farms with organizations representative of numerically important size-type groups were studied in detail as an aid in determining adjustments that individual farmers might be able to make.

Data concerning possible crop yield and livestock production rate increases were obtained from specialists of the Mississippi Experiment Station. Census data were also used as an aid in describing the Area.

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GENERAL CHARACTERISTICS OF THE SHORTLEAF PINE AREA

The Shortleaf Pine Area consists of 21 counties, approximately 7.6 million acres, located in the central and north-central part of the State, extending from the Tennessee line on the north to the Alabama line on the east.

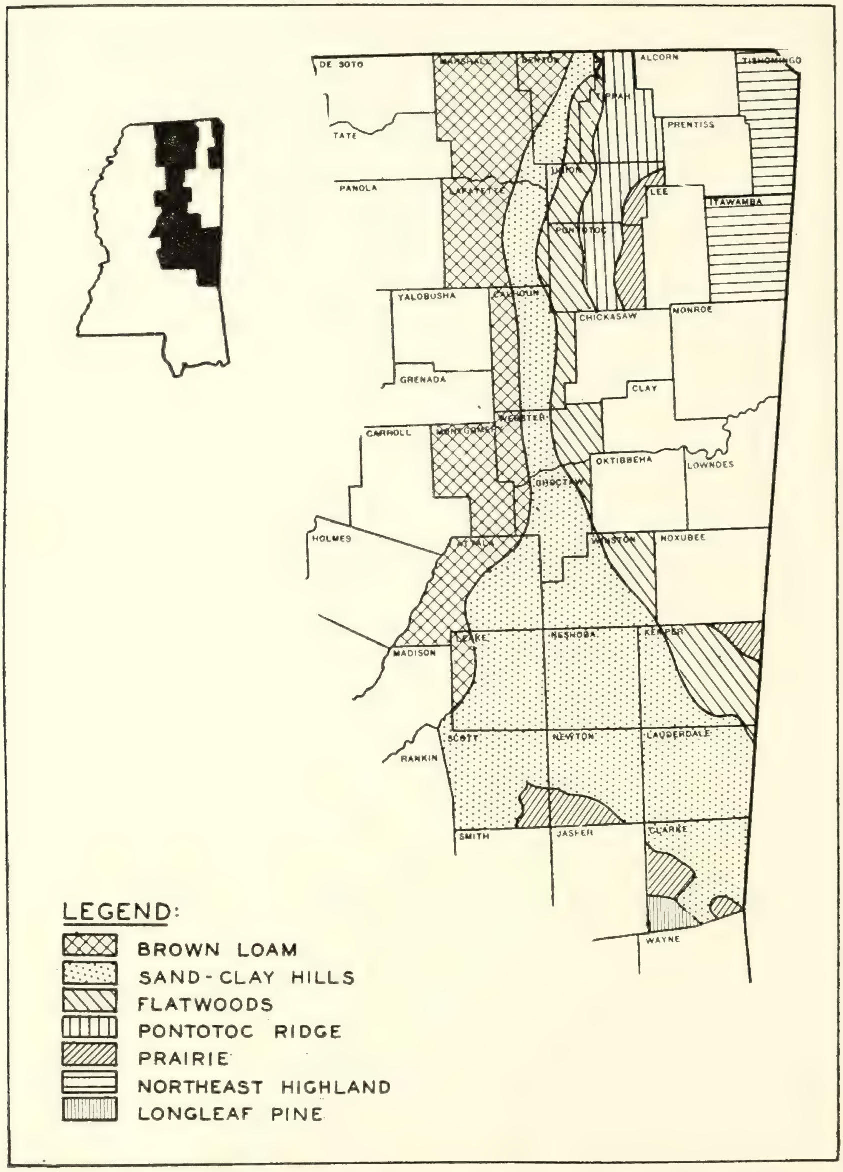

Figure 1. Physiographic divisions of the Shortleaf Pine type-of-farming Area.
Source: "Soils Guide for Mississippi," by J. C. Scott, Extension Soils Specialist.

(Figure 1). Two counties in the northeast corner of the State are also included with this Area even though separated from it by a narrow strip of the Northeast Prairie type-of-farming Area.

Land Use

In 1940, land in farms accounted for 68 percent of all land in the Area. For the State as a whole 63 percent of all land was in farms. Of the total farm land in the Area in 1940, 32 percent was in cropland, 14 percent in plowable pasture, 33 percent in woods, and 21 percent in other uses. For the State as a whole these figures were 38, 14, 32, and 16 percent, respectively. Crop acreages have declined in the Shortleaf Pine Area since 1920. Of the land in crops in 1939, 27 percent was in cotton, 43 percent in corn, and 9 percent in tame hay. (Table 1).

Physical Resources[1]

The average frost-free season ranges from 210 days in the northern part of the Shortleaf Pine Area to 240 days in the southern part. Late summer droughts are not infrequent, and the falls are usually dry. Annual precipitation ranges from an average of 47.7 inches in Pontotoc County to 59.1 inches in Newton.[2]

Soils were developed principally from the clays and sands deposited in the ancient Gulf of Mexico, which is now known as the Gulf Coastal Plain. The principal upland soil series developed from this material in the Shortleaf Pine Area include Kirvin, Ruston, Shubuta, Cuthbert, and Susquehanna. The lighter soils (Ruston and Kirvin) are very satisfactory for row crops when slopes are not too steep. The Shubuta, Cuthbert, and Susquehanna soil series were developed from heavy material and are less suited to row crops. Terrace land soil series in these same areas include Prentiss, Kalmia, Stough, and Myatt. Prentiss and Kalmia, when not too sandy, are well suited to the production of row crops, as well as oats and lespedeza. Stough, an imperfectly drained, and Myatt, a poorly drained series, are more suitable for pasture and

Table 1. Land use in the Shortleaf Pine Area of Mississippi, 1920-40, with comparison.[1]

Item	Shortleaf Pine Area			Mississippi
	1920	1930	1940	1940
	Percent	Percent	Percent	Percent
Total land area in farms	73	66	68	63
Farm land in cropland[2]	28	30	32	38
Farm land in plowable pasture	—[3]	8	14	14
Farm land in woodland	44	42	33	32
Farm land in other uses	28[4]	20	21	16
Cropland in corn	53	37	43	40
Cropland in cotton	32	44	27	33
Cropland in tame hay	7	4	9	4

[1] U. S. Census of Agriculture. [2] Cropland in 1920 is the sum of "land in principal crops;" in 1930 and 1940, it is the sum of "harvested" and "failure." [3] Not ascertainable. [4] For 1920 includes plowable pasture.

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[1] Acknowledgment is due Kenneth V. Goodman, Associate Soil Scientist of the BPISAE, who prepared the soils phases of this discussion.

[2] U. S. Department of Agriculture Yearbook, "Climate and Man," 1941.

hay crops. Better drained soils of the bottomland include the Ocklocknee and Iuka series, both of which are well suited to corn and, in a lesser degree, to cotton. The Bibb series is poorly drained and is best suited to pasture or forestry.

A narrow strip of silty material, supposedly wind-blown, ranging in thickness from a few inches to many feet, has been deposited along the western side of this Area, particularly in Marshall and Lafayette Counties in the northwestern corner. The principal soil series of the upland of this small section include Memphis, Loring, Grenada, Calloway, and Henry, ranging in degree of drainage from very good to poor. Most of the best cropland occurs in the Memphis, Loring, and Grenada series. Because of the silty material in the soils of these series, however, the best cropland is readily subject to accelerated erosion and needs careful handling to prevent the formation of gullies. A wide variety of crops, except those requiring sandy textures—like peanuts—can be grown on these series, and yields are generally high with moderate applications of complete fertilizer. The Calloway and Henry series are somewhat poorly drained, occur largely on fairly level land, and are more adapted to pasture, lespedeza, and corn than to other crops. The principal soil series on the terrace land associated with the foregoing soils include Richland, Lintonia, Olivier, Calhoun, and Carroll. The best cropland is found in the first two series and will grow almost any of the common crops. In the Calhoun and Carroll series the cleared land is generally imperfectly or poorly drained and is better adapted to pasture, lespedeza, sorghum, or corn. In some areas certain soils are somewhat alkaline and may be adapted to alfalfa. Bottomland soil series with about the same range in drainage and adaptation as the foregoing terrace land include Vicksburg, Collins, Falaya, and Waverly. The cropland in the first two series is of good quality and is adapted to the common crops of the vicinity, while that in the latter two is more adapted to pastures, sorghums, oats, corn, or forestry, depending on the particular soil type (fine sandy loam or clay) involved.

Between the soil series developed from the sands and clays of the "Clay Hills" proper and the series developed from the "wind-blown" silt deposits (on the western side) are several series with mixed materials. The most important are the Lexington, Providence, and Falkner, and associated imperfectly or poorly drained soils. These soils as a unit have very thin silty or very fine sandy loam surfaces underlain by sandy or clayey material, and are very erosive. Great care must be exercised in handling the cropland in such types. Most of the common crops of the vicinity are grown on the well-drained cropland, while pastures and grain crops are grown on the cleared land of the imperfectly or poorly drained types. On the sandy types of the Lexington and Providence series sweetpotatoes and peanuts, in addition to the other crops, can be grown successfully. The soil series on the terrace land derived principally from mixed materials include Dexter, Freeland, Hatchie, and Almo, grading from very well drained to poorly drained. The best cropland, and probably the most extensive in the terrace land, is found in the first three series, and the highest yielding land occurs in the first two within this group. The series found on the bottomland include Shannon, Hymon, Ina, and Beechy. The best cropland is found in the first two series, the poorest in the last. The Ina series is better for pasture and corn, but has been used occasionally for other crops. The Beechy series is almost entirely adapted to forestry or pasture.

Most upland soils in the "mixed" soil areas and sand-clay hills proper (comprising the major portion of the Shortleaf Pine Area) need large applications of fertilizer for consistently good yields, but in the silty or "Brown Loam" part of the Shortleaf Pine Area, the amount of fertilizer required is more variable, depending upon the soil, crop, and rainfall relationships.[3] It is possible to apply too much fertilizer in this section, in that the higher yield may not justify the cost of the additional fertilizer. This is also true for some of the bottom and terrace lands, although up to the present time the error has been to apply too little fertilizer, even on these soils.

The amount of really good land in the Shortleaf Pine Area is not high. Of the cropland within this area, probably not over 30 percent could be considered as first-class for all the major crops, including peanuts and sweetpotatoes. Many of the soils with heavy textures and imperfect drainage must be handled with special care to prevent puddling of the soil or to prevent crop losses from diseases or weeds that flourish in these damp soils. About 90 percent of the cropland is suited to crops of one sort or another, but the kind of crops selected will depend to a large extent on the soil types, degree of erosion, and the size of farms. Peanuts, for example, should not be grown in heavy soil types, and sweetpotatoes should not be grown in poorly drained soils. Corn, on the other hand, should not be grown in very deep sandy soils or on the very shallow, gravelly, or rocky types. Cotton needs comparatively heavy soils for best results, and truck crops need loamy soils with good moisture-holding capacity.

The topography ranges from rolling to steep. Although there are numerous small areas of bottomland in the Shortleaf Pine Area, some of the most rugged land in the State is found there. The character of the soil, the type of agriculture generally followed, and the topography combine to make conditions favorable for excessive erosion. An evidence of the effect of erosion has been the abandonment of many acres of cropland in the Area. (Abandoned acres have been practically replaced by bringing new land into cultivation.) Soil losses can be minimized without interfering with usual farm operations by the adoption of conservation practices. The surface has barely been scratched so far as total erosion control needs are concerned.

Timber ranks next to agriculture as a source of income in this Area. While one-third of all land in farms in 1939 was in forest, farmers reported that only 3 percent of the value of all farm products sold or traded came from forest products. For the State as a whole this amounted to only 1.1 percent.[4] A large part of timber production in the Shortleaf Pine Area comes from nonfarm forests. Since 1939, returns from timber on farms have increased materially, as cutting has exceeded growth during the war period.

The development of mineral resources in the Area has not been of importance.

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[3] "Brown Loam" soils occur in the Shortleaf Pine type-of-farming Area as delineated on figure 1 largely because county lines were followed in outlining the area for consideration in this bulletin.

[4] U. S. Census of Agriculture, 1940.

Population

The 1940 population of the Shortleaf Pine Area was 476,393, of which 414,406, or 87 percent, were reported as rural (farm and nonfarm)· Rural-farm population was reported as 71 percent of the Area's population. The proportion of the total population residing in rural parts of this Area is somewhat greater than in the State as a whole. Likewise, the proportion of the total population which is white, is higher in this Area, 65 percent, compared with 51 percent for the State. Increases in total and in all segments of the population, rural, urban, white, and negro, were at a lower rate in this Area between 1900 and 1940 than for the whole State. (Table 2).

Estimates indicate that this Area lost 14 percent of its rural-farm population and 29 percent of its farm labor force between April 1940 and March 1943. This decrease was greater than in other parts of Mississippi. The movement of workers from the Area has continued since 1943, though probably at a reduced rate. Whether this labor will return to the Area after the war will depend on alternative employment opportunities. In addition to those who have left the Area since 1940, there are many who continue to reside there but commute daily to non-farm jobs in Memphis and other nearby urban centers.

The high ratio of workers to resources is indicated by the fact that agricultural production has increased during the war even though an estimated 29 percent of the pre-war farm labor force had left by March 1943. There is some question whether the remaining labor force is fully utilized except during the cotton-picking season. Table 3 compares agricultural resources per rural resident of the Shortleaf Pine Area with resources available per rural resident in other type-of-farming areas.

Industrial Development

In 1940, 61 percent of the people employed in the Shortleaf Pine Area were engaged in agriculture, slightly higher than the State average of 58 percent. For the whole South 31.5 percent were employed in agriculture, but in the United States only 18.5 percent were thus employed. (Table 4).

In 1940, only 4 percent of all employed people were engaged in manufacturing, exclusive of sawmills, planing mills, and logging, as compared with

Table 2. Total population 1900-1940, composition and trends, Shortleaf Pine Area of Mississippi, with comparison.[1]

	Shortleaf Pine Area			Mississippi		
Item	1900	1940	Percent change	1900	1940	Percent change
Total population	372,308	476,392	28.0	1,551,270	2,183,796	41.0
Negro population	147,619	165,003	12.0	907,630	1,074,578	18.0
Rural population	355,444	414,406	17.0	1,431,235	1,750,914	22.0
Percent Negro	39.6	34.6	—5.0	58.5	49.2	9.3
Percent rural	95.5	87.0	—8.5	92.3	80.2	12.1
Percent rural-farm	—[2]	71.4	—	—[2]	64.1	—
Percent rural-nonfarm	—[2]	15.6	—	—[2]	16.1	—

[1] U. S. Census of Population, 1900 and 1940.

[2] Not available.

Table 3. Land use and livestock numbers per rural resident, by type-of-farming areas, Mississippi, 1943.[1]

Item	Type-of-farming area							
	Short-leaf Pine	Delta	Brown Loam	North-east Prairie	Long-leaf Pine	Coastal Plain	Gulf Coast	State
Land use:								
Acres of farmland	17.7	10.4	16.5	15.5	16.8	16.9	14.4	15.3
Acres of cropland	6.6	8.0	6.5	6.7	6.7	5.4	2.6	6.8
Acres of cotton	1.5	3.4	1.8	1.6	1.5	0.5	—[2]	2.0
Acres of corn	2.7	1.7	2.2	3.6	2.9	1.8	0.8	2.3
Livestock and livestock products:								
Milk cows, no.	0.5	0.2	0.4	0.7	0.4	0.4	0.6	0.4
Cattle and calves, no.	1.1	0.4	1.5	1.3	1.3	1.6	2.5	1.1
Sows farrowed, no.	0.2	0.2	0.3	0.2	0.2	0.4	0.4	0.2
Milk produced, lbs.	1,260	631	1,113	2,081	968	893	1,692	1,127
Eggs produced, doz.	53	25	36	43	59	49	112	42

[1] Computed by applying the change in total population of rural counties as indicated by the U. S. Census of Population for 1940 and Ration Book No. 2 registration to the rural farm population of the same counties as reported by the Census.

[2] Less than 0.05 acres per rural resident.

Table 4. Occupation of employed persons in the Shortleaf Pine Area of Mississippi, 1940, with comparisons.[1]

Item	Shortleaf Pine Area	Mississippi	South[2]	United States
Total employed, number	142,468	727,455	13,777,858	45,166,083
Percent in agriculture	60.8	57.7	31.5	18.5
Percent in manufacturing	10.0	9.2	15.9	23.4
Percent in manufacturing (excluding sawmills, planing mills, and logging)	4.0	5.3	13.5	22.1
Percent in service trades[3]	24.9	28.2	43.9	49.8
Percent in other occupations[4]	3.1	3.9	7.6	6.8
Percent not reporting occupations	1.2	1.0	1.1	1.5

[1] Census of Population, 1940. Does not include employment on public emergency work.

[2] The "South" includes the states of Alabama, Arkansas, Delaware, Florida, Georgia, Kentucky, Louisiana, Maryland, Mississippi, North Carolina, Oklahoma, South Carolina, Tennessee, Texas, Virginia, West Virginia, and the District of Columbia.

[3] Includes transportation, communication, and other public utilities; wholesale and retail trade, finance, insurance and real estate; business and repair services, personal services, amusement, recreation and related services; professional and related services; and government.

[4] Includes construction, mining, fishing, and forestry (except logging).

5.3 percent for the State, 13.5 percent for the South, and 22.1 percent for the Nation. Service trade employed 25 percent of the people employed in the Shortleaf Pine Area in 1940, 28 percent in the State, 44 percent in the South, and 50 percent in the United States.

Institutional Resources

Marketing facilities for handling the cotton crop are adequate. In addition to 280 cotton gins, there were 23 cotton warehouses in the Area in 1942, 12 of which wre equipped with compresses. There were also four cotton oil mills in the Area.

A number of assembling and processing plants for dairy products are

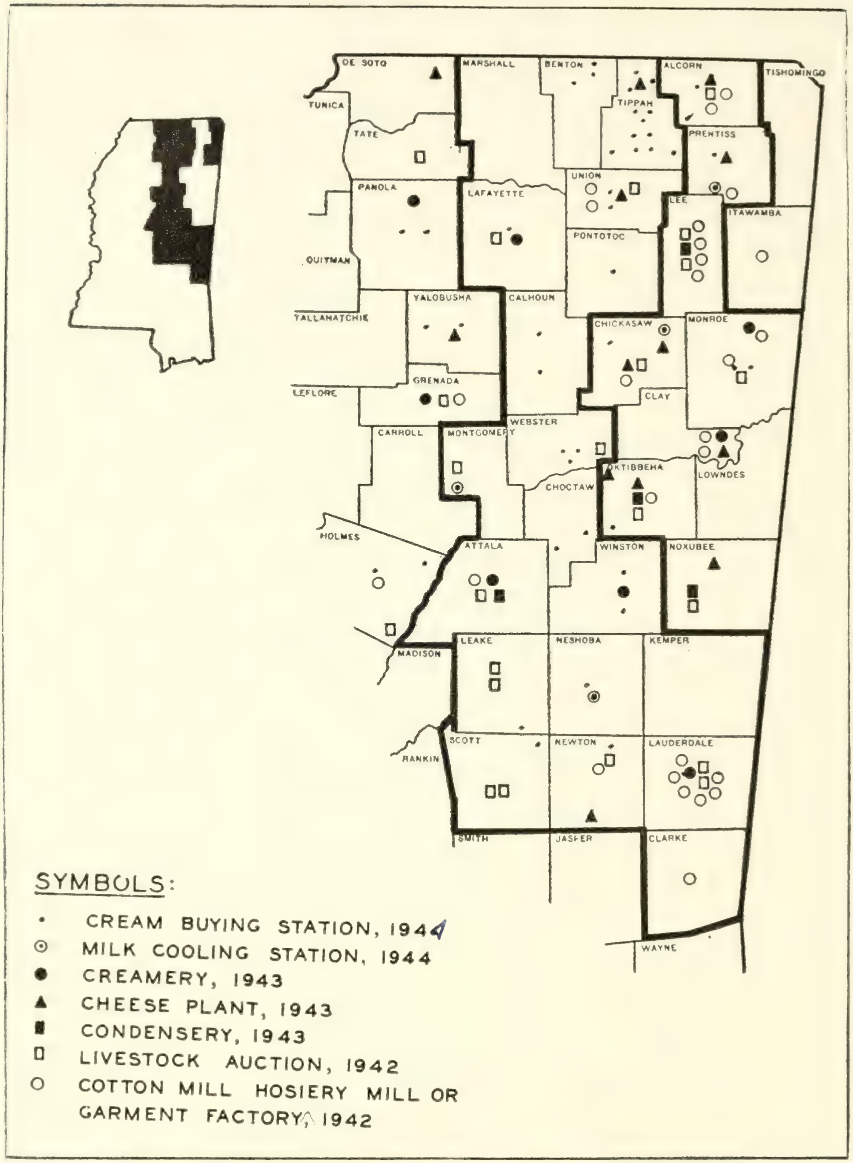

Figure 2. Marketing and processing facilities.

located in the Area. Included are 5 creameries, 5 cheese plants, 1 milk condensing plant, 1 powdered milk plant, 3 ice cream plants, 2 cooling stations, and 32 cream buying stations. (Figure 2). Many communities are not served by milk or cream routes and farmers must provide their own transportation if they are to sell dairy products. Transportation costs involved prevent many potential milk producers (at present prices) from developing the dairy enterprise. Some of the existing milk routes could be extended, but the scarcity of trucks and drivers under war conditions has limited extensions or the starting of new routes. During the war many potential producers of dairy products not on milk routes and desiring to get into the dairy business could sell butterfat in the form of cream to local cream buying stations.

Facilities for marketing livestock appear adequate. There are several slaughter establishments and one meat packing plant in the Area.

Marketing facilities for farm products, other than cotton, dairy, livestock, and timber, have not been developed. Some trading centers offer adequate markets for poultry and eggs, while others do not.

FARM ORGANIZATION AND MANAGEMENT

Distribution of Farms According to Size and Type

Small cotton-type farms predominate in this Area. Although farms have been considered small, medium, or large in size, according to whether or not they were operated by one, two, or three or more families, by many measures 95 percent of the farms would be considered small.[5] According to the criteria used in classifying a 20 percent sample of operating units as defined by the AAA, however, 65 percent were one-family, 21 percent were two-family, and 14 percent were units with three or more families.[6]

The cotton-type farm predominates in all size groups. Although farms have been grouped into five types, the cotton crop is of great importance in every type defined. Fifty-one percent of all farms were classified as of the **cotton** type, 28 percent **general,** 10 percent **cotton-dairy,** 4 percent **cotton-cattle,** and 7 percent **cotton-livestock.** (Table 5).

Farm types used as the basis for classifying Shortleaf Pine Area farms are defined as follows:

(1) **Cotton:** farms with at least 20 percent of their cropland in cotton, less than four cows, and no other important source of income.

Table 5. Percentage distribution of farms by type and size in the Shortleaf Pine Area, Mississippi, 1941.[1]

Type of farm	All sizes	Size of farm (No. of families per farm)		
		One family	Two families	Three or more families
	Percent	Percent	Percent	Percent
Cotton	51	35	11	5
General	28	21	5	2
Cotton-dairy	10	4	3	3
Cotton-cattle	4	2	1	1
Cotton-livestock	7	3	1	3
All types	100	65	21	14

[1] Based on a 20 percent sample of AAA worksheets from Calhoun, Leake, and Winston Counties.

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[5] The number of families per farm has been used as the measure of farm size in this analysis. Acres of cropland per farm, regardless of the number of families per farm, would also have been a satisfactory measure. It is believed that results would have been very much the same, as those in table 5 had cropland rather than number of families been the measure.

[6] According to the census, 37 percent of all farms were operated by croppers in 1939. This ties in closely with the classification of AAA worksheets in that 35 percent of all farm units were found to be operated by 2 or more families.

(2) **General:** farms without enough cotton to be included within the cotton type, or enough livestock to be included within the livestock type.

(3) Cotton-livestock: farms with at least 20 percent of their cropland in cotton and a substantial part of their income from livestock.

(4) **Cotton-dairy:** farms on which cotton and dairy cows account for most of the cash income, the two enterprises being equal, or nearly equal, in importance. In one sense, this might be considered a sub-type of (3) above.

(4) **Cotton-cattle:** farms on which cattle, for dairy replacement or beef purposes (or both), are of importance, but on which cotton is the major crop. This type group might also be considered a sub-type of (3) above.

Size and type of farm are also indicated by the source and amount of farm income. In 1939, 71 percent of the value of all farm products sold or traded was from crops, 26 percent from livestock, and 3 percent from forest products. Farm income from products sold, traded, or used, on the average, amounted to only $410 per "census farm," of which 44 percent represented the value of farm products used by the household. (Table 6).

Table 6. Source and average amount of income per "census farm," Shortleaf Pine Area, 1929 and 1939, with comparison.[1]

Item	Shortleaf Pine Area		Mississippi
	1929	1939	1939
Value of all farm products sold, traded, or used, dollars	782	410	546
Value of all farm products sold or traded, dollars	579	230	397
Percent from crops	80	71	84
Percent from livestock	17	26	15
Percent from forest products	3	3	1
Value of all farm products used by farm household, dol.	203	180	149
Percent of farms on which value of farm products sold, traded, or used by household amounted to:			
Less than $250	[2]	32	25
Less than $400	[2]	62	49

[1] U. S. Census of Agriculture.

[2] Not available.

Cropland Resources of Farms in Size-Type Groups

As stated elsewhere, cropland resources per farm are inadequate with present technology and would remain inadequate with improved technology unless the acreage of cropland per family were increased. This is not to imply, however, that improved technology is not desirable. The use of better farm practices as a means toward higher productivity would raise the income of farm families, but could not raise it to an adequate level because the cropland available per capita, under 1941 conditions, would not permit.

According to the analysis of 1941 AAA records, approximately 29 acres of cropland (part of which was idle) were available per farm family.[7]

The situation (per family) differed but little by size of farm, although more cropland was usually available per family on farms with livestock as an important source of income. (Table 7). Farms with livestock as an important enterprise represented only 21 percent of all farms. Families on cotton type farms had available, on the average, only 25 acres of cropland. The average farm had between 1 and 2 families—1.7, as nearly as can be estimated. Twenty-three percent of the farms had less than 20 acres of cropland, while 87 percent had less than 80. (Table 8).

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[7] In 1940 the average "census farm" in the Shortleaf Pine Area had 24.5 acres of crops, of which 6.5 were in cotton and 10.5 in corn.

Table 7. Cropland acreage per farm, by type and size of farm, Shortleaf Pine Area, Mississippi, 1941.[1]

Type of farm	Acres of cropland per farm, by size of farm: Average for all sizes of farms	Farms with one family	Farms with two families	Farms with three or more families
Cotton	36	28	46	77
General	36	29	49	85
Cotton-dairy	75	47	57	119
Cotton-cattle	71	44	62	142
Cotton-livestock	119	66	52	176
All types	47	32	49	117

[1] Based on a 20 percent sample of AAA worksheets from sample counties.

Table 8. Distribution of farms by acres in cropland per farm, Shortleaf Pine Area, Mississippi, 1941.[1]

Acres of cropland	Percent	Cumulative percentage
0 - 19	23.2	—
20 - 39	35.9	59.1
40 - 59	19.4	78.5
60 - 79	8.3	86.8
80 and above	13.2	100.0
Total	100.0	—

[1] Based on a 20 percent sample of AAA worksheets in sample counties.

Utilization of Land in Farms

In 1940 the average "census farm" in the Shortleaf Pine Area had 24.5 acres of crops, of which 6.5 acres were in cotton, 10.5 in corn, 7.5 in other crops, and 25.5 in woods. (Table 9). This checks very closely with the acreage available per family in 1941 according to AAA records. A more detailed analysis of land use on farms representative of specific size-type groups is indicated in another part of this bulletin.

Table 9. Land use on farms in the Shortleaf Pine Area, 1920-1940, with comparison.[1]

Average acres per farm	Shortleaf Pine Area 1920	Shortleaf Pine Area 1930	Shortleaf Pine Area 1940	Mississippi 1940
	Number	Number	Number	Number
Total	86.0	69.6	76.4	65.8
Crops	36.7	21.0	24.5	25.3
Cotton	7.7	10.4	6.5	8.4
Corn	12.7	8.4	10.5	10.2
Other crops	16.3	2.2	7.5	6.7
Woods	37.7	29.0	25.5	20.9
Other uses	11.6	19.6	26.4	18.6

[1] U. S. Census of Agriculture.

Tenure and Color of Farm Operators

Owners operated 42 percent of the farms and 65 percent of the total farm acreage of the Shortleaf Pine Area in 1940. This was slightly higher than in 1930, but lower than in 1920. Farm ownership is more general in this Area than in the State as a whole. White operators are also relatively more numerous. There has been little change in the last 20 years either in the percentage of farms operated by whites or in the proportion of the total acres operated by whites. The percentage of farm land operated by white owners of this Area is higher than in the remainder of the State. (Table 10).

Farm operators in this Area, on the average, are slightly older than in the State as a whole. In 1940 the average age of all operators in the Area was reported by the census as 44 years. Full owners averaged 50 years of age.

Table 10. Tenure and color of farm operators in the Shortleaf Pine Area of Mississippi, 1920-1940, with comparison.[1]

Item	Shortleaf Pine Area			Mississippi
	1920	1930	1940	1940
Percent of farms operated by owners	46	38	42	30
Percent of farm land operated by owners[2]	68	64	65	59
Percent of farms operated by whites	67	66	65	45
Percent of farm land operated by whites	78	75	78	72
Percent of farm land operated by white owners	[3]	49	50	44

[1] U. S. Census of Agriculture.

[2] Includes that owned and operated by full owners plus that operated by part owners.

[3] Not available.

The Agricultural Pattern During World War II

During World War II the pattern of agriculture in the Shortleaf Pine Area has changed, but the changes have not been as great as in areas where peanuts, for example, have expanded so rapidly. Some of the shifts under way before the war, particularly the shift from corn to oats, have continued. The acreage of cowpeas has declined markedly, chiefly because of the high price of seed. The acreage of idle cropland has doubled since 1941, and is one of the reasons why yields have increased during the war. (Table 11). Cropland left idle was relatively inferior in most cases. Small farm operators and their families leaving for war work was primarily responsible for the decrease in crop acreage. Data concerning acreage shifts for other crops and for livestock are shown in table 11.

Table 11. Land use, livestock numbers and livestock products in the Shortleaf Pine Area of Mississippi, 1941-1944, and suggested goals for 1945.[1]

Item	Acreage	1941	1942	1943	1944	Suggested goal 1945[2]
Crop acres:		1,000 acres	1,000 acres	1,000 acres	1,000 acres	1,000 acres
Corn	Planted	835.0	802.0	755.0	709.0	732.0
Oats for grain	Harvested	20.7	26.5	34.7	45.0	73.5
All tame hay	do.	222.2	222.0	196.0	194.0	252.1
Sorghums (except sirup)	Planted	7.8	7.1	8.1	8.6	7.9
Soybeans for beans	Harvested	6.9	14.0	11.0	9.0	10.0
Cowpeas for peas	do.	76.4	59.2	25.2	18.0	(6)
Peanuts, picked and threshed	do.	10.7	30.5	12.5	11.8	15.7
Cotton	Planted	425.6	429.0	458.5	429.0	452.4
Irish potatoes	do.	5.2	6.5	6.4	6.2	7.0
Sweetpotatoes	do.	13.7	14.4	17.2	14.8	18.1
Seed crops	Harvested	10.0	10.0	9.0	10.0	11.5
Cropland pasture	Planted	30.0	30.0	30.0	30.0	*
Idle cropland	——	210.0	235.0	324.0	416.0	*
Total cropland	——	1,938.0	1,938.0	1,938.0	1,938.0	1,938.0
Wild hay	Harvested	24.4	20.7	22.0	22.8	*
Open permanent pasture	——	1,127.6	1,131.3	1,130.0	1,129.2	*
Woodland pasture	——	944.0	944.0	940.0	940.0	*
Total land in farms	——	5,204.0	5,204.0	5,200.0	5,200.0	*
Livestock and livestock products:	Unit	1,000 units	1,000 units	1,000 units	1,000 units	1,000 units
Milk cows	Number	141.9	149.9	156.0	159.0	162.0
Other cattle	do.	159.3	162.3	171.0	181.0	179.2
Hens and pullets	do.	1,692.0	1,886.0	2,141.0	2,366.0	2,029.0
Sows farrowed	do.	25.9	35.6	48.7	34.7	[3]
Milk produced	1000 lbs.	349.0	375.0	365.8	373.0	400.8
Eggs produced	1000 doz.	11.2	13.3	13.8	14.4	*
Chickens raised[4]	Number	4,059.0	4,827.0	5,685.0	4,780.0	3,878.0
Turkeys raised	do.	16.0	16.0	17.4	16.7	18.2

[1] Based on unofficial county estimates.
[2] Mississippi goals handbook for 1945.
[3] Goal for spring farrowing only.
[4] Including commercial broilers except for 1945 goal.
*No goal.

Usual Versus Improved Production Practices

The avenue of improved crop and livestock practices offers the best opportunity for farmers in this Area to increase farm income. Crop yields have been much too low. Through improved practices yields can be substantially increased and returns per acre raised accordingly. Cotton yields, for example, could be raised an estimated 46 percent over the level considered normal for 1943, while corn yields could be almost doubled. Yields of other important crops could also be raised significantly. Estimates concerning yield increases possible through improved production practices were made by experiment station agronomists. (Table 12).

The rapidity with which these yield increases (for the entire Area) can be achieved depends partly upon the rapidity with which educational services can be expanded. Prices, markets, and credit facilities are other important factors. Any individual farmer, however, could raise his yields to the in-

Table 12. Estimates of specified crop yields possible as a result of following recommended improved production practices, Shortleaf Pine Area of Mississippi.

Crop	Acreage	Unit	Yield per acre			
			Average 1937-41 1/	1943 Normal 2/	With improved practices 3/	Increase with improved practices
			Units	Units	Units	Percent
Corn, all	Planted	Bu.	13.8	14.1	28	99
Soybeans for beans	Harvested	Bu.	6.4	10.5	12	14
Cowpeas for peas	do.	Bu.	4.8	5.1	15	194
Peanuts threshed	do.	Lb.	460	460	800	74
Cotton	Planted	Lb.	211	240	350	46
Sorghum for sirup	Harvested	Gal.	69	70	100	43
Sugarcane for sirup	do.	Gal.	134	133	200	50
Irish potatoes	Planted	Bu.	58	59	75	27
Sweetpotatoes	do.	Bu.	85	83	125	51
Oats for grain	Harvested	Bu.	21	21.5	35	63
Hay, all tame	do.	Ton	1.2	1.15	1.4	22
Sorghum for hay	do.	Ton	1.2	1.15	1.4	22
Sorghum for silage	do.	Ton	—	—	15	—

1/Base data from unofficial estimates.

2/"Normal" yield as used in this situation means the yield that could have been expected in 1943 had weather conditions been normal. Actual yields were above or below this estimate. Its chief purpose is to show the progress that has been made in improving yields since the base period. This, in turn, would measure the progress that has been made in the adoption of improved practices.

3/Assumes widespread adoption of improved crop production practices.

dicated level within a year or two by following practices recommended by the experiment station.

Improved practices of most importance include: (1) Proper fertilization, which in turn involves use of the correct amount, the recommended analysis, and correct placement in relation to the roots of the plant; (2) use of high quality seed of the recommended variety and strain; (3) seed treatment; (4) planting at the correct time; (5) using enough seed (involves correct spacing in the row and between rows); (6) proper cultivation; and (7) proper harvesting methods. Other bulletins of this Station can be consulted for additional details concerning improved practices.

The use of additional quantities of fertilizer and lime can be expected to have more influence on yields than other improved practices, but all are important. The quantity of fertilizer constituents used in 1943 (the year used for comparative purposes in table 12) was much greater than in 1941. (Table 13.) Opportunities exist, however, for the use of much greater quantities than have been used during any of the war years. Table 13 indicates the quantity of fertilizer elements used annually in the Shortleaf Pine Area during the period 1940-1944.

Cotton Production Practices

Proper fertilization is most important among improved cotton production practices. The use of recommended seed varieties and adapted strains could be extended, however, to an estimated additional 30 percent of the acreage. Most Shortleaf Pine Area farmers dust cotton (to control boll weevil) in seasons when that is necessary. (Table 16).

Although 81 percent of the cotton growers interviewed reported the use

Table 13. **Quantity of fertilizer elements sold in the Shortleaf Pine Area of Mississippi, for use during the 1940-1944 crops years.**[1]

For crop of	Total all elements	Nitrogen (N)	Phosphate (P_2O_5)	Potash (K_2O)
	tons	tons	tons	tons
1941	12,448	4,648	5,042	2,758
1942	13,303	4,181	6,079	3,143
1943	16,091	5,055	7,258	3,778
1944	16,627	6,461	6,706	3,460

[1] Compiled from "County Fertilizer Data," State Department of Agriculture.

of fertilizer on cotton in 1941, the quantity applied per acre was much too low. Most growers—73 percent of those using fertilizer—applied between 200 and 300 pounds of mixed goods per acre, the "usual" rate being 200 pounds of 4-8-4. Recommendations specify 500 pounds of the 6-8-4 analysis. Less than 4 percent of the growers applied the recommended quantity of fertilizer in 1941 and few used the recommended analysis. Table 14 indicates the proportion of cotton growers interviewed who applied fertilizer at specified rates in 1941. Farmers have applied more fertilizer to cotton during the war years than in 1941. Even so, there continues to be an opportunity to increase yields substantially through heavier applications of the recommended analyses.

Corn Production Practices

Less than one-third (31 percent) of the Shortleaf Pine Area corn growers used fertilizer on corn in 1941, and few of that group fertilized correctly. In fact, only 3 percent applied nitrogen at the recommended rate, which is 30 pounds of nitrogen (N) or approximately 200 pounds nitrate of soda, or its equivalent, per acre. Seventy-four percent of those using fertilizer used nitrate of soda. The usual rate of applying nitrate of soda, by those who used it, was 100 pounds per acre. A small proportion of those using nitrate

Table 14. **Proportion of cotton growers applying mixed fertilizer to cotton at specified rates in 1941, Shortleaf Pine Area of Mississippi.**[1]

Rate of application	Proportion of growers applying at specified rate
Pounds per acre	Percent
0	19.0
25	.0
50	1.0
75	.0
100	3.0
125	1.0
150	3.0
175	3.0
200	21.0
225	3.0
250	10.0
275	2.0
300	23.0
325	.0
350	2.0
375	.0
400 and above	9.0
	100.0

[1] Based on records from representative farms in important size-type groups.

of soda also used mixed fertilizer on corn. As with cotton, there is "much room for improvement" in corn fertilization practices followed by farmers in this Area. Table 15 indicates the proportion of farmers intervewed who applied nitrate of soda at specified rates in 1941. It is believed that most of the additional fertilizer purchased during the war years has been used on the cotton crop.

Other improved corn practices (table 16) include the use of adapted varieties and strains. Very few farmers used corn seed of recommended varieties and strains in 1943. The estimate is 5 percent. Recommendations do not refer to hybrid seed corn, inasmuch as satisfactory hybrids for general adoption throughout the State are not available. There are, however, improved strains available which if used more generally would materially increase yields. Proper cultivation and land selection are also considered important from the standpoint of increasing yields. Practically speaking, proper land selection involves keeping corn off the eroded hillsides, using such areas for close growing crops, pasture, or trees.

Improved Practices for Other Crops and Pasture

Significant increases can be made in the yield of cowpeas, peanuts, sweetpotatoes, oats, hay, and pastures. Details concerning these practices can be obtained by reference to table 16 and to other publications of the Mississippi Experiment Station.

Hay and pasture practices have been severely neglected. The yield of lespedeza hay, for example, could be raised greatly by applying 200 pounds of 20 percent superphosphate, or its equivalent, and harvesting at the proper stage. It is estimated that only 10 percent of the farmers applied phosphate on lespedeza in 1943. A somewhat larger proportion—perhaps 40 percent—harvested at the correct stage of maturity.

Better pastures are essential if the livestock raising possibilities of the Area are to be realized. Improving pastures appears to be expensive, but such practices as applying phosphate, lime, seeding, clearing and mowing, increase the carrying capacity of permanent pastures a great deal above that attainable from unimproved pastures. Temporary pastures for use in both winter and late summer are needed to supplement permanent pastures if

Table 15. Proportion of corn growers applying nitrate of soda on corn at specified rates in 1941, Shortleaf Pine Area of Mississippi.1/

Rate of application	Proportion of growers applying nitrate of soda at specified rate
Pounds per acre	Percent
0	77
25	0
50	3
75	2
100	14
125	0
150	1
175	0
200	1
225 and above	2
	100

1/Based on records from representative farms in important size-type groups.

Table 16. Estimated extent to which specified improved production practices were carried out in 1943, by crops, Shortleaf Pine Area, Mississippi.[1]

Crop	Improved practice	Estimated proportion of acreage on which practice was used in 1943
		Percent
Cotton (Yields could be raised an estimated 45 percent)	Fertilizing with 500 lbs. 6-8-4 on upland or 500 lbs. 6-8-8 on bottomland	25
	Using seed of adapted varieties	70
	Dusting for boll weevil when conditions make it necessary	Need varies—an indication for 1943 would not be particularly meaningful
Corn (Yields could be raised an estimated 95 percent)	Application of 100 lbs. ammonium nitrate per acre (or equivalent)[2]	10
	Using seed of adapted varieties and strains as recommended	25
	Thorough cultivation at the proper time	40
	Selecting land properly (keeping corn off eroded hillsides)	80
Cowpeas (Yields could be raised an estimated 22 percent)	Application of 200 lbs. of 20 percent superphosphate (or its equivalent) per acre	15
	Using seed of adapted varieties as recommended	30
	Harvesting hay at right stage of maturity	40
Peanuts (Yields could be raised an estimated 60 percent)	Applying 100 lbs. of 20 percent superphosphate plus 50 lbs. of muriate of potash (or equivalent) per acre or good rotation program	20
	Using seed of adapted varieties and of good quality as recommended	20
	Keeping down weeds	20
Sweetpotatoes (Yields could be raised an estimated 50 percent)	Application of 800 lbs. 5-10-5 per acre	25
	Using seed of adapted strains	60
	Use of correct cultural methods—proper height of ridge, correct spacing of plants, correct planting date, careful handling at harvest time	70
Oats (Yields could be raised an estimated 60 percent)	Application of 100 lbs. ammonium nitrate (or equivalent) per acre	25
	Using adapted varieties of seed as recommended and enough seed per acre	65
	Harvesting with efficient machinery, cutting at proper stage of maturity	60
Lespedeza hay (Yields could be raised an estimated 50 percent)	Application of 200 lbs. 20 percent superphosphate (or equivalent) per acre	10
	Harvesting at correct stage of maturity and with efficient equipment	40
	Controlling weeds	15
Permanent pasture (Improved) (Carrying capacity could be increased an estimated 75 percent)	Application of from 200 to 300 lbs. 20 percent superphosphate (or equivalent)	10
	Application of 100 lbs. muriate of potash (or equivalent) each third year	2
	Stocking with correct number of animal units per acre	15
	Mowing to control weeds	20
Temporary pasture (Summer)	Application of from 200 to 300 lbs. 20 percent superphosphate (or equivalent) and 100 pounds of ammonium nitrate on non-legumes plus 100 lbs. muriate of potash (or equivalent) per acre each third year	5
Temporary pasture (Winter)	Application of 200 lbs. 0-14-7 per acre	5
	Application of 100 lbs. ammonium nitrate (or equivalent) per acre on non-legumes	30

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[1] Estimates by technicians of the Mississippi Agricultural Experiment Station. It is believed that these practices "would pay" on practically the entire acreage grown in the Shortleaf Pine Area. In addition to the practices enumerated above, it is estimated that about 80 percent of the cropland in the area should be limed with an initial application of 1,000 pounds and repeated as required.

[2] Equivalent of 100 pounds ammonium nitrate would be 200 pounds nitrate of soda, for example.

maximum returns are to be secured from livestock. Not only will requirements for the feeding of grain and storage roughage be reduced when adequate pastures are available, but more economical production will result.

A small grain, usually oats, seeded with a winter clover will generally provide winter grazing and offer some protection to the soil. Such grazing crops should be planted in late August or early September for best results and may be grown on land from which corn is to be harvested. When seeded to lespedeza in February, summer pasture or hay may be grown on the same land.

Improved Livestock Practices

Livestock production rates—dozens of eggs per hen, gallons of milk per cow, or beef production per head—like crop yields, have been much too low. Realization of improved production returns will depend almost entirely on the success of a program to increase feed crop yields and the grazing capacity of pastures. It will also be necessary to substantially expand the acreage of pasture.

Improved grain feeding rates and the provision of adequate roughages are of most importance in increasing livestock production. The usual practice in 1941, for example, was to feed milk cows only 520 pounds of concentrates and 1,700 pounds of hay, compared with a suggested feeding rate of 1,400 pounds of concentrates and 2 tons of hay. Hens received only 25 pounds of concentrates, compared with a need for 85 pounds. (Table 17). Other practices of importance include better housing, culling, and disease and parasite control. Improved breeding of productive livestock would also help greatly.

If improved practices were followed milk production per cow could be raised as much as 90 percent, although it is not anticipated that the average for the Area could be raised to that extent within any reasonable length of time. Egg production per hen could be almost doubled.

Table 17. Usual and improved feeding rates for important classes of livestock, Shortleaf Pine Area of Mississippi.[1]

Class of livestock	Usual feeding rates		Improved feeding rates	
	Concentrates	Hay	Concentrates	Hay
	Pounds	Pounds	Pounds	Pounds
Workstock	2,500	1,800	3,000	2,200
Milk cows	520	1,700	1,400	4,000
Hogs[2]	[3]	—	389	—
Chickens	25	—	85	—

[1] "Usual rates" determined on basis of 1941 data from representative farms. Improved rates estimated by livestock production specialists of the Mississippi Agricultural Experiment Station.

[2] Per hundred pounds of pork produced.

[3] Not available.

Per Acre Returns From Principal Crops

The acreage of cotton, corn, small grains, or any other crop a farmer decides to grow usually depends more on his estimate of expected per acre returns than on any other factor. Table 18 summarizes returns that might be expected from producing an acre of cotton, corn, sweetpotatoes, or oats and lespedeza. Returns shown in that table are not strictly comparable because cotton is usually grown on the best land. Yields and returns from the other crops would undoubtedly be higher, in other words, if they were grown on land of the quality used for cotton.

Two measures for comparing returns from the principal crops of the Shortleaf Pine Area are used in table 18. These measures and their definitions are as follows:

(1) **Returns per acre over direct cash expenses** represent the amount left after cash expenses have been subtracted from gross income. All "out-of-pocket" cash expenses for producing the crop in question are taken into account.

(2) **Returns per acre to land and management** represent the returns after all production costs, exclusive of management and use of land, have been considered. Items included in addition to those in (1) above are: value of all labor used in producing the crop, value of horse or mule power, and the proportion of the farm machinery maintenance costs properly chargeable to the particular crop in question.

Per acre returns over direct cash expenses—$49.70 for cotton, $25.57 for corn, $88.60 for sweetpotatoes, and $28.13 for oats and lespedeza—were not

Table 18. Estimated per acre returns from principal crops with assumed post-war prices and improved yields, Shortleaf Pine Area of Mississippi.[1]

Item	Cotton	Corn	Oats and lespedeza	Sweet-potatoes
Yield with improved practices:	Pounds	Bushels	Bu. & Tons	Bushels
Lint, grain, pork, or No. 1 potatoes	350	28	35	80
Cottonseed, hay, or No. 2 potatoes	577	—	1.4	45
Labor required per acre:	Hours	Hours	Hours	Hours
Man	135	40	21	100
Mule	42	35	26	55
Price per pound, ton, or bushel:[2]	Dollars	Dollars	Dollars	Dollars
Lint, grain, or No. 1 potatoes	0.14	1.04	0.58	1.25
Cottonseed, hay, or No. 2 potatoes	47.35	—	14.40	0.36
Gross value of crop[3]	62.66	29.12	40.46	112.60
Direct cash expenses:				
Fertilizer[4]	7.46	2.55	4.59	12.00
Seed	2.00	1.00	4.74	4.00
Ginning, bagging, and ties	3.50	—	—	—
Combining oats or containers for sweetpotatoes	—	—	3.00	8.00
Total	12.96	3.55	12.31	24.00
Returns over direct cash expenses (per acre)	49.70	25.57	28.13	88.60
Other expenses:				
Man labor at 20 cents per hr. (value or cost if hired)	27.00	8.00	4.20	20.00
Mule work at 13 cents per hr.	5.46	4.55	3.38	7.15
Machinery at 3 cents per hr. of mule labor	1.26	1.05	.78	1.65
Total expenses	46.68	17.15	20.69	52.80
Returns to land and management (per acre)	15.98	11.97	19.77	59.80

[1] Returns per acre from principal crops are not strictly comparable in this analysis because yields are Area averages. As such, they represent yields from the class of land on which these crops are generally grown. The best land, for example, is ordinarily used for cotton. Yields of corn and oats would undoubtedly be higher if these crops were planted on the quality of land generally used for cotton.

[2] Assumed prices for the post-war period.

[3] Does not include the value of corn stover or oats for winter pasture.

[4] Assumes fertilizer practices specified in table 16.

as high before the war as those shown in table 18. Attainment of this level of income per acre, which depends on the obtaining of improved yields, would make possible a relatively prosperous agriculture in the Shortleaf Pine Area.

Although returns to land and management would be almost as high from corn as from cotton (table 18), farmers could be expected to continue to grow relatively large acreages of cotton because it provides a way in which family labor can be employed. Per acre returns over direct cash expenses, in other words, are more meaningful to the farmer with his own labor supply than to the farmer who must hire most of his labor. Returns shown in table 18 are entirely dependent on realization of the assumed prices and upon obtaining the improved yields specified.

Reorganizing Representative Farms

Farm incomes in the Shortleaf Pine Area are too low to provide adequately for farm needs. Furthermore, the predominant system of farming contributes to serious erosion damage. These conditions could be improved by adjusting the organization of individual farms to take advantage of improved crop and livestock production practices that will increase yields and conserve the soil simultaneously. Unfortunately, the number of production alternatives—crop or livestock enterprises that can successfully be substituted for cotton—is not great. Cotton remains of relatively great importance in each of the suggested plans for reorganizing the farm business. It has been necessary to suggest the expansion of enterprises which furnish use for the maximum amount of labor because the acreage of land available per family is very small. Even with reorganization, the usual family labor supply will not be fully employed during several months of the year.

While increasing the size of farms has not been shown as one of the desirable adjustments in the examples of farm reorganization which follow, it would be very desirable in many cases. The effects of increasing size of farm on income can be noted by comparing returns from farms of different sizes.

Individual farms representative of numerically important groups of farms, are used to illustrate the adjustments which should be made and to show the corresponding effects on income and expense items. Under reorganization the plans outlined would provide for a much higher standard of living, assuming realization of assumed prices.

Making the changes suggested would not be easy, but it is believed that many farmers could complete the suggested adjustments within 3 to 5 years. The relative desirability of alternative adjustments will depend to a large extent on prices for competing products after the war. Two different sets of prices have been used to test the adjustments suggesed for individual farms. They are: (1) average prices received by Mississippi farmers during the period 1937-1941, and (2) assumed prices for the post-war period. Increases in income in the first adjustment over the original are then due to changes in enterprises and to the use of improved practices, while further increases, as shown in the second adjustment column for each illustrative example, result from price changes.

The most difficult phase in adjusting the farm organizations will be that of increasing and improving the acreage of pasture. In most cases it will be necessary to clear woods for additional pasture acreages and improve the acreage already being used as open pasture by mowing, seeding, and fertilizing. Kudzu has been suggested as suitable for a part of the permanent pasture acreage on each farm reorganized. It is presumed that it would be planted on the steeper portions of the acreage selected for pasture.[8] An adequate amount of pasture must be available if livestock enterprises, around which most improvements in the plans are built, are to succeed.

There is considerable evidence that part of the woodland on farms could be cleared and used for crops or pasture. Eighty-two farmers who were questioned concerning the woodland acreage of their farms reported that they had woodland totaling 4,699 acres, of which, in their opinion, 44 percent was suitable for cropland or pasture, and that an additional 14 percent would be suitable for pasture (but not cropland) if cleared. Returns from farm woodlands were quite low in 1941. Returns averaged only $0.36 per acre on 82 farms surveyed, with most of the returns coming from sawtimber. Possibilities for increasing returns through improved woodland practices are excellent. Foresters report that annual returns from properly handled farm forests can be expected to range from $2.00 to $5.00 per acre.

Small grains would furnish winter cover for cropland on the reorganized farms. Seed of Austrian winter peas and the vetches are costly and often fail to produce a stand, or in the event the stand is satisfactory, fail to make enough growth to justify the expenditure. Fertilizer nutrients in many cases can be purchased most cheaply in the form of commercial fertilizer.

Plans for farm reorganization discussed in the following paragraphs include the use of improved crop yields shown in table 12. Improved livestock production rates are also assumed. The suggested acreage shifts would help, but yield increases must, of necessity, be obtained along with these shifts if the plans for raising farm income are to be successful.

Farm reorganization suggestions are designed for the "Clay Hills proper" section (figure 3) of the Shortleaf Pine type-of-farming Area, although they would apply in a general way to the Brown Loam soil areas which constitute a part of several counties along the western edge of the Area. The recommendations would not apply to the area known as the Pontotoc Ridge section, which extends along the northeast side of the Area. Woodland on farms in that section is too rugged and steep to make clearing for pastures a reasonable undertaking.

Reorganizing a Very Small Cotton Farm

In reorganizing a farm in this group it should be recognized that no amount of planning can reasonably be expected to enable a family with such a small acreage of cropland to earn an adequate income. By present standards, however, the increased amount of cash that would be available for family living would represent a very definite improvement. An operator would need additional land before he could raise earnings to a point that

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[8] Data concerning the details of establishing and maintaining permanent pastures can be obtained from Bulletin 356 of the Mississippi Agricultural Experiment Station. Data concerning the production of improved pastures can be obtained from Bulletin 412 of the same Station.

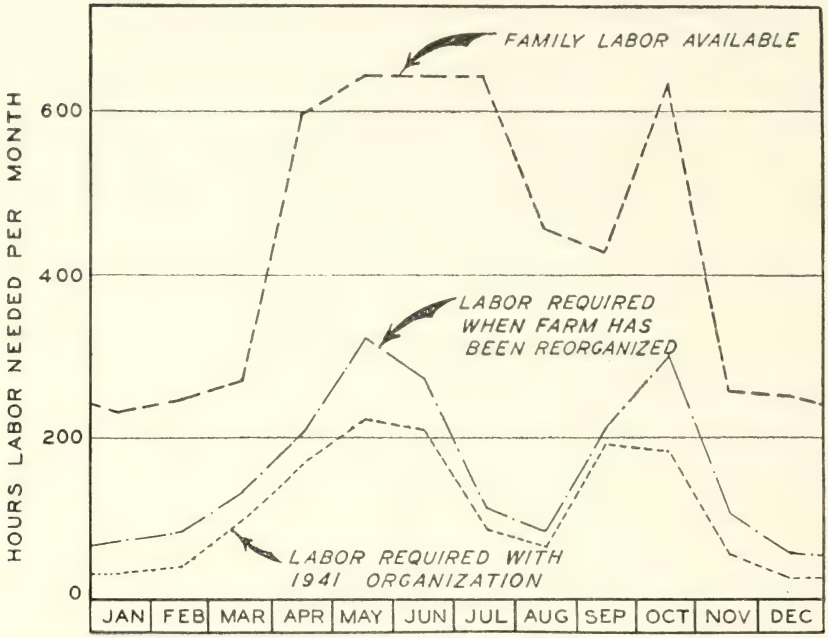

Figure 3. Labor available and required to operate a very small cotton farm before and after reorganization of crop and livestock enterprises and the adoption of improved production practices, Shortleaf Pine Area of Mississippi.

would be considered adequate by most standards. The plan of organization suggested for larger farms will indicate in a general way what the very small cotton farm operator might expect to accomplish by increasing the size of his holdings.

The very small cotton farm used for purposes of illustration in table 19 had only 16 acres of cropland, 2 acres of pasture, and 22 acres of woods in 1941.[9] Under the suggested system of reorganization the acreage of open pasture would be raised to 10, the acreage of woodland reduced proportionately. Enough woodland would remain to furnish fuel for the home.

Two crop acreage changes are important in the suggested plan. Corn acreage would be reduced from 8 to 5, with oats followed by lespedeza for hay being grown on the 3 acres. Two acres of sweetpotatoes would supplement 5 acres of cotton (which would remain the same as at present) as a source of cash income.

Livestock organization changes are limited to the addition of 2 milk cows and 30 hens. These enterprises would increase cash income by the sale of cream and eggs. (Table 19). With the number of livestock suggested it would be necessary to purchase feed valued at $75 with 1937-41 prices.

If improved yields are obtained and suggested organizational changes made, net cash income should be increased from $92 to $297, assuming 1937-41 prices for products bought or sold. If assumed post-war prices are realized, net cash income could be raised to an estimated $551.

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[9] The analysis of AAA records previously described indicates that almost one-fourth of the operating units in the Shortleaf Pine Area had less than 20 acres of cropland in 1941.

The amount of labor required to operate the reorganized farm would be increased but would not be expected to effectively utilize the full time of a family with an average supply of labor. Figure 3 compares the amount of family labor required to operate the very small cotton farm before and after reorganization. It has been assumed that the family consists of the operator, his wife, a son 15 years of age and a daughter 13. The son would be available for chore labor the year round and for field work during 5 months of the year. The daughter would not be considered available for work except during October, at which time she would pick cotton. The wife was considered 70 percent as effective as a man for most types of farm work. She was not considered available for chore labor because of household duties, but was considered available for field work during "peak" labor requirement periods.

Reorganizing a Small Cotton Farm

The general character of changes suggested for reorganizing a small cotton farm is the same as those suggested for the very small cotton farm. The essential difference is that the very small farm would sell butterfat as cream whereas this farm would sell whole milk as an additional source of cash income. Opportunities to earn a living on this unit are better because the amount of cropland available—30 acres compared with 16—is greater.

Success with the plan outlined in table 20 would necessitate conversion of 14 acres of woodland to permanent pasture and improvement of 6 acres of open land already being used for pasture. Cotton acreage would remain the same, but corn acreage would be reduced from 13 acres to 9. Eight acres of oats followed by lespedeza for hay and grazing would be grown on the land idle in the original organization and on the displaced corn acreage. Sweetpotatoes—4 acres—would supplement cash income from cotton. It would represent a new enterprise from the standpoint of production for sale. The cropland acreage (30) would remain the same after reorganizing this unit, although 4 acres of land idle under the original organization would be used for crops. Important changes in the livestock enterprise would include the addition of 3 milk cows and 20 chicken hens.

If livestock production rates and crop yields shown in table 12 were obtained on this farm, net cash farm income could reasonably be expected to increase from $170 to $664, if prices prevailing during the period 1937-41 were obtained. If the higher schedule of assumed prices were obtained (appendix table 1), net cash farm income could be expected to reach $1,250—enough to raise the standard of living to what might be termed a minimum adequate level.

Adequate pasture for the livestock would be furnished by 20 acres of permanent pasture, of which 5 would be kudzu. Four acres of Korean lespedeza, and 8 acres of oats would also be available. The 4 acres of lespedeza and 8 acres of oats would provide an adequate amount of hay. Improved corn and oat yields would make possible the production of enough feed grain to eliminate the purchase of feed grains.

Table 19. Suggested organization and financial summary of a very small cotton farm, with comparison, Shortleaf Pine Area of Mississippi.

Item	Farm organization and income[1]		
	Usual (1941) organization using 1937-41 prices	Suggested reorganization	
		Using 1937-41 prices	Using assumed post-war prices
Land use:	Acres	Acres	Acres
Cropland	16	16	16
Open permanent pasture	2	10	10
Woods and waste	22	14	14
Total	40	40	40
Crops:			
Cotton	5	5	5
Corn	8	5	5
Sweetpotatoes	—	2	2
Cowpeas for hay	1	—	—
Oats for hay	—	3	3
Annual pasture (lespedeza after oats)	—	(3)*	(3)
Oats for winter pasture (after corn)	—	(5)	(5)
Garden, orchard, sirup, and truck	1	1	1
Idle	1	—	—
Livestock:	Number	Number	Number
Workstock	1	1	1
Milk cows	1	3	3
Other cattle	1	2	2
Hogs	2	2	2
Hens	20	50	50
Value of property:	Dollars	Dollars	Dollars
Land	630	630	630
Improvements	300	400	400
Machinery	45	60	60
Livestock	112	255	335
Total	1,087	1,345	1,425
Cash receipts:			
Cotton, lint and seed	158	230	313
Sweetpotatoes	—	134	200
Butterfat	—	98	190
Beef calves	13	47	67
Chickens	—	17	24
Eggs	2	89	122
Total	173	615	916
Cash expenses:			
Fertilizer and lime	22	140	140
Seed	7	20	20
Other crop expenses	15	36	36
Livestock expenses	8	26	28
Feed	13	75	120
Machinery hire	2	4	4
Building and machinery repair	14	17	17
Total[2]	81	318	365
Net cash farm income[3]	92	297	551
Value of products used by family	129	175	247
Total farm family income[4]	221	472	798
Interest on investment at 5 percent	54	67	71
Depreciation	26	32	32
Family labor earnings[5]	141	373	695
Total hours of man labor required per year	1,367	1,950	1,950
Family earnings per hour of labor	0.10	0.19	0.36

[1] See appendix table 1 for prices of specific farm products.

[2] Exclusive of AAA payments.

[3] **Net cash farm income** is the amount remaining after total cash expenditures for operating the farm have been subtracted from total receipts.

[4] **Total farm family income** is computed by adding the value of farm products used by family to net cash farm income.

[5] **Family labor earnings** are computed by subtracting depreciation and interest on the investment from total farm family income.

*Figures in ( ) indicate double crop acres.

Table 20. Suggested organization and financial summary of a small cotton farm, with comparison, Shortleaf Pine Area of Mississippi.

Item	Farm organization and income[1]		
	Usual (1941) organization using 1937-41 prices	Suggested reorganization	
		Using 1937-41 prices	Using assumed post-war prices
Land use:	Acres	Acres	Acres
Cropland	30	30	30
Open permanent pasture	6	20	20
Woods and waste	44	30	30
Total	80	80	80
Crops:			
Cotton	8	8	8
Corn planted alone	13	9	9
Sweetpotatoes	0.2	4	4
Oats for hay (after corn)	—	8	8
Lespedeza (after oats)	3.5	(8)*	(8)
Oats for winter cover (after sweetpotatoes)	—	(4)	(4)
Garden and orchard	1.3	1	1
Idle	4	—	—
Livestock on hand during year:	Number	Number	Number
Workstock	2	2	2
Milk cows	2	5	5
Other cattle	1	5	5
Hogs	2	2	2
Hens	30	50	50
Chickens	40	100	100
Value of farm property:	Dollars	Dollars	Dollars
Land	1,240	1,240	1,240
Improvements	400	600	600
Machinery	110	110	110
Livestock	212	548	767
Total	1,962	2,498	2,717
Cash receipts:			
Cotton, lint and seed	253	367	501
Sweetpotatoes	—	269	400
Butterfat	20	—	—
Milk, whole	—	280	535
Calves	20	79	125
Dairy cow (every other year)	—	20	31
Chickens raised	—	17	25
Eggs	9	90	123
Forest products	17	40	40
Total[2]	319	1,162	1,780
Cash expenses:			
Fertilizer and lime	52	221	221
Seed	15	64	64
Other crop expenses	32	72	72
Livestock expenses	9	34	36
Feed	14	65	110
Machinery hire	4	8	8
Building and machinery repair	23	27	27
Interest on production credit loan	—	7	7
Total	149	498	545
Net cash farm income[3]	170	664	1,235
Value of farm products used by family	163	188	266
Total farm family income[4]	333	852	1,501
Interest on investment at 5 percent	98	125	136
Depreciation	40	52	52
Family labor earnings[5]	195	675	1,313
Hours of man labor required per year	1,950	3,103	3,103
Family earnings per hour of labor	0.10	0.22	0.42

See footnotes table 19, page 24.

Table 21. **Suggested organization and financial summary of a medium-size cotton-dairy farm, with comparison, Shortleaf Pine Area of Mississippi.**

Item	Farm organization and income[1]		
	Usual (1941) organization using 1937-41 prices	Suggested reorganization	
		Using 1937-41 prices	Using assumed post-war prices
Land use:	Acres	Acres	Acres
Cropland	50	50	50
Open improved pasture	7	40	40
Woodland pasture	63	—	—
Woodland pasture	63	—	—
Total	120	120	120
Crops:			
Cotton	14	14	14
Corn	20	10	10
Oats for grain, hay and pasture	4	20	20
Lespedeza for hay and pasture	—	(20)	(20)
Cowpeas or soybeans for hay	5	—	—
Oats and bur clover for pasture	—	5	5
Sorghum for silage	—	(6)	(6)
Garden, truck and small fruit	1	1	1
Idle	6	—	—
Livestock:	Number	Number	Number
Workstock	2	2	2
Milk cows	15	15	15
Calves for veal	5	5	5
Heifers	3	3	3
Bull	1	1	1
Hogs	2	2	2
Hens	50	50	50
Chickens raised	100	100	100
Value of property:	Dollars	Dollars	Dollars
Land	1,955	1,955	1,955
Improvements	600	750	750
Machinery	200	250	250
Livestock	770	1,365	1,600
Total	3,525	4,320	4,555
Cash receipts:			
Cotton, lint and seed	441	645	876
Milk, whole	322	1,013	1,950
Veal calves	47	95	126
Dairy cows	40	80	124
Chickens raised	6	17	25
Eggs	33	209	286
Woodland	—	40	40
Total[2]	889	2,099	3,427
Cash expenses:			
Fertilizer and lime	82	419	419
Seed	27	39	39
Other crop expenses	34	53	53
Livestock expenses	29	29	31
Feed	53	127	219
Machinery hire	—	114	114
Building and machinery repair	30	33	33
Interest	—	9	9
Total	255	823	917
Net cash farm income[3]	634	1,276	2,510
Value of farm products used by family	163	188	266
Total farm family income[4]	797	1,464	2,776
Interest on investment at 5 percent	176	216	228
Depreciation	72	86	86
Family labor earnings[5]	549	1,162	2,462
Hours of man labor required per year	4,095	5,297	5,297
Family earnings per hour of labor	0.13	0.22	0.46

See footnotes table 19, page 24.

Reorganizing a Medium-Size Cotton-Dairy Farm

As on the other reorganized farms an obstacle to making the suggested adjustments on this unit will be the difficulties associated with the establishment of improved pasture, although the amount of woodland that would need to be cleared would not be as great as on the cotton-livestock farm.

It was considered desirable to maintain 14 acres of cotton on this farm. Corn acreage would be cut in half and oats followed by lespedeza would be substituted. Six acres of sorghum would be grown for silage, while oats and bur clover would furnish a temporary pasture during winter and early spring. No changes are suggested in livestock numbers. (Table 21).

The success of the plan for reorganizing the cotton-dairy farm will depend primarily upon the raising of yields, particularly feed grain yields, so that dairy cows may be fed at rates that will result in the economical production of milk. If the suggested plan for reorganization is successful, net cash income could be raised from $634 to $1,276, assuming 1937-1941 prices. If assumed post-war prices were effected, it is estimated that net cash farm income could be raised to $2,510.

The reorganized cotton-dairy farm would utilize the family labor supply fairly effectively during most of the year. (Figure 4). For purposes of illustration, it was assumed that the family labor supply used in figure 4 was furnished by a family consisting of an operator, his wife, one son over 21, one son in high school who would be available for work during 5 months of the year, and one daughter about 12 years of age.

Some cotton-dairy farms with 50 acres of cropland will not have woodland which would be suitable for pasture when cleared. In such cases, part of the cropland could be used for pasture and the farm could be reorganized along the lines suggested for the small cotton farm, which has 30 acres of cropland. Although net cash income would be considerably below the amount indicated when woods can be cleared for pasture, income would be well above that possible with the present organization and usual yields.

Reorganizing a Medium-Size Cotton-Livestock Farm

The reorganized cotton-livestock farm—which becomes a cotton-beef cattle type when reorganized—represents a type of adjustment that would provide an adequate standard of living for families with as much as 50 acres of cropland. It is believed that many farm operators with the required amount of cropland and enough woodland suitable for conversion to pasture could make these adjustments. The greatest obstacles would be associated with the conversion of 73 acres of woodland to improved pasture. (Table 22).

The livestock organization on this unit would be based on 20 beef cows and three dairy cows, from which 16 beef calves weighing about 400 pounds each would be sold every fall. Cash income would be supplemented by the sale of cotton, surplus milk from 3 dairy cows, and eggs and poultry from a 150-hen flock. The family labor supply of an average size farm family would be adequate to do the farm work required with the reorganized unit.

Obstacles to Farm Reorganization

A number of the obstacles that would be encountered in making changes suggested for the four representative farms have already been mentioned.

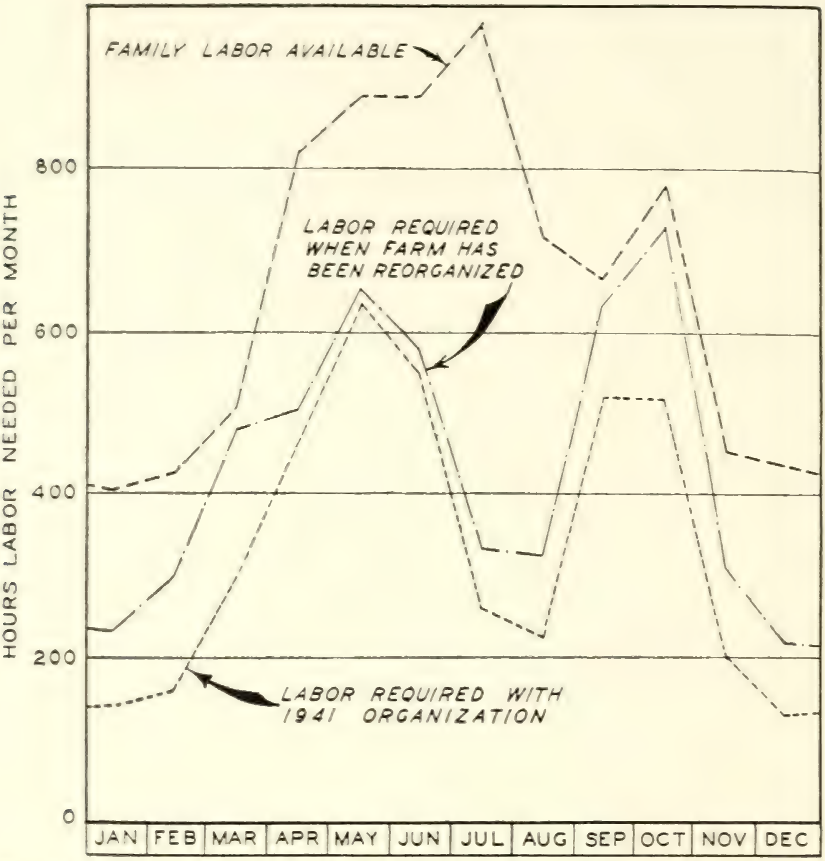


Figure 4. Labor available and required to operate a medium sized (50 acres cropland) cotton-dairy farm before and after reorganization of crop and livestock enterprises and the adoption of improved production practices, Shortleaf Pine Area of Mississippi.

There are many others, a few of which will be discussed below.

If farms already large enough to provide an adequate standard of living for farm families were to remain the same in size and "too small" farms were to be enlarged so that they have 50 acres of cropland (or even 30) it would be necessary to displace a very large number of families, many more than any type of program now visualized could handle. That being the case, the best alternative would seem to be to improve the income on farm units as they now exist, taking full advantage of technological advances, including improved crop and livestock practices and making every effort to conserve the remaining limited soil resources of the Area. If these things are done, agricultural income of the Area would be greatly increased with any reasonable schedule of prices.

Some of the suggested changes could be made in one year's time. Correct fertilization is an example, because that is the most important practice so far as yield increases are concerned. And until yield increases are ob-

Table 22. Suggested organization and financial summary of a medium-size cotton-livestock farm with comparison, Shortleaf Pine Area of Mississippi.

Item	Farm organization and income[1]		
	Usual (1941) organization using 1937-41 prices	Suggested reorganization	
		Using 1937-41 prices	Using assumed post-war prices
Land use:	Acres	Acres	Acres
Cropland	50	50	50
Open improved pasture	7	80	80
Woodland pasture and waste	183	—	—
Woodland not pasture and waste	—	110	110
Total	240	240	240
Crops:			
Cotton	14	14	14
Corn	20	10	10
Oats for grain, hay, and pasture	4	20	20
Lespedeza (after oats) for hay and pasture	(4)	(20)	(20)
Cowpeas or soybeans for hay	5	—	—
Oats and bur clover for pasture	—	5	5
Sorghum for pasture	—	(5)	(5)
Garden, truck and small fruit	1	1	1
Idle	6	—	—
Livestock on hand during year:	Number	Number	Number
Workstock	2	2	2
Milk cows	3	3	3
Beef cows	5	20	20
Heifers	2	6	6
Bull	1	1	1
Beef calves	5	17	17
Sow	1	—	—
Hogs (other)	11	2	2
Hens	50	150	150
Chickens raised	100	200	200
Value of property:	Dollars	Dollars	Dollars
Land	2,625	2,625	2,625
Improvements	600	700	700
Machinery	200	250	250
Livestock	620	1,710	2,035
Total	4,045	5,285	5,610
Cash receipts:			
Cotton, lint, and seed	441	645	876
Oats	—	67	86
Butterfat	—	124	239
Cattle	144	530	841
Hogs	60	—	—
Chickens	12	55	78
Eggs	33	328	448
Forest products	80	160	160
Total[2]	770	1,909	2,728
Cash expenses:			
Fertilizer and lime	48	250	250
Seed	24	30	30
Other crop expenses	34	53	53
Livestock expenses	18	43	43
Feed	12	122	219
Machinery hire	—	42	42
Building and machinery expenses	30	33	33
Taxes	—	—	—
Interest	—	6	6
Total	166	579	676
Net cash farm income[3]	504	1,233	1,787
Value of farm products used by family	163	188	266
Total farm family income[4]	667	1,421	2,053
Interest on investment at 5 percent	202	264	280
Depreciation	72	86	86
Family labor earnings[5]	393	1,071	1,687
Hours of man labor required per year	3,305	4,213	4,213
Family labor earnings per hour of labor	0.12	0.25	0.40

See footnotes table 19, page 24.

tained little real progress can be effected. Pasture establishment, fraught with many difficulties, can be accomplished by close attention to recommendations. Cattle must have a cheap source of roughage if production is to "pay off."

Not all farm operators with farms similar to those reorganized could be expected to make and integrate the changes suggested. Above-average managerial ability would be necessary, although farmers with average or below average ability could make the changes with close supervision, provided they were willing to follow instructions. There is some doubt if credit facilities usually available to farmers in the Area could be expected to provide the needs of a farmer making the changes called for, particularly when it is recalled that many farmers already have mortgages which they are struggling to eliminate. This situation plus the wariness which many operators have of contracting larger indebtedness in the interest of higher future incomes (which in turn are highly dependent on fluctuating prices), makes it extremely difficult to induce farmers to make the more or less radical changes that have been suggested.

In some cases the value of timber would pay for clearing and pasture establishment, but in most cases a special type of intermediate credit—a "transitional" credit—would be absolutely necessary. Credit terms would need to be very liberal, with deferred repayment plans based on the length of time required to get the "new" system of farming on a paying basis. It might be as long as 7 to 8 years before repayments could start, although in many cases repayment could be started within a shorter period. It seems obvious that tenants must have long term leases if they are to make the kind of adjustments suggested.

In order that a small acreage of sweetpotatoes might be grown for out-of-state markets on a substantial number of farms in the Area, additional facilities would be required for curing, storing, and marketing. To be most successful, farms growing sweetpotatoes should be concentrated in rather restricted areas in order that the necessary facilities might be developed and operated most economically. Curing and storing could be accomplished on individual farms or at central locations operated by either individuals or co-operatives. The important point would be to develop such volume as to justify the necessary facilities, and assure a uniform product of high quality.

Educational services concerning the problems of improved farm management must be expanded if small farm operators like those in the Shortleaf Pine Area are to be made to fully understand and appreciate their opportunities. Their lack of understanding concerning the value and paying ability of better management is one of the main reasons improved crop and livestock practices, for example, have not been more generally adopted.

Summary

The Shortleaf Pine is predominately an area of small cotton farms. Population pressure on the land remains very great, notwithstanding the fact that an estimated one-third of the working force has left the Area during the war. The predominant farming system has resulted in tremendous erosion losses which have been only partially arrested. Conservation needs are great for cropland, pasture, and woodland. Because of poor management practices, many farmers with large acreage of cropland are in as difficult a position as those with smaller acreages.

Possibilities for raising farm incomes through shifts in crop acreages and livestock numbers and the adoption of improved production practices are good. Organizational adjustments would be profitable with any reasonable schedule of post-war prices that might be visualized. Although per acre returns can be substantially increased, the acreage of cropland on some farms is so small that no amount of planning could reasonably be expected to raise farm incomes to an adequate level. Outside employment and an enlargement in farm size represent the only alternatives. Notwithstanding the fact that crop acreages are extremely small on a large proportion of the operating units, improved production practices and acreage shifts would be desirable even though "adequate" incomes might never be obtained. The points listed below will serve to indicate in summary form some of the factors that influence opportunities for improving the status of farm families in the Area.

(1) The soils are inherently poor in fertility, although responsive to fertilizer treatments. Relatively large quantities of fertilizer are needed to make production profitable.

(2) The rural character of the Area is indicated by the fact that 87 percent of the population in 1940 was rural and that 71 percent was rural-farm.

(3) Sixty-one percent of the working force was employed in agricultural pursuits in 1940, compared with 19 percent in the Nation as a whole. Ten percent was employed in manufacturing, compared with 23 percent for the entire United States.

(4) A smaller proportion of the population is colored than in the State as a whole. Only 35 percent of the population was colored in 1940, whereas the figure for the State was 49 percent.

(5) Farm operating units, by most standards, would be considered extremely small. According to an analysis of the 1941 AAA records, 87 percent of the farms had less than 80 acres of cropland, 59 percent had less than 36 acres, and 23 percent had less than 20 acres. In 1940, 42 percent of the farm operators were owners who operated 65 percent of the farm land.

(6) Income from livestock represents only a small proportion of the total farm income. According to the census, income from crops accounted for 71 percent of the value of farm products sold or traded. Livestock accounted for 26 percent and forest products for 3 percent.

(7) Farm incomes have been extremely low. According to the 1939 census, 62 percent of all farms averaged less than $400 in farm products sold, traded, or used. Thirty-two percent of the farms averaged less than $250 worth of farm products sold, traded, or used.

(8) The pressure of population on land is indicated by the fact that in 1943 there were only 6.6 acres of cropland per rural resident. These data

were secured from a compilation of sugar ration books. Of this acreage, 1.5 acres were in cotton and 2.7 in corn. According to an analysis of a 20 percent sample of AAA records in 1941, the average farm family had at its disposal only 29 acres of cropland. Families operating strictly cotton-type farms had available only 25 acres, part of which was idle. The acreage of cropland available per family on multiple-family farms was usually no larger than on the one-family farms. In many cases it was smaller.

(9) Fifty-one percent of all farms in the Area were classified as cotton-type farms. Although livestock was of greater importance on other types of farms, cotton was an important source of income on practically all farms. In 1939, 27 percent of the cropland was in cotton, 43 percent in corn, and 9 percent in tame hay.

(10) Opportunities for increasing crop yields are good. Crop specialists have indicated that the average yield of cotton could be raised 46 percent. Corn yields could be raised almost 100 percent. Livestock production rates could also be increased greatly through better practices. It has been estimated that egg production per hen could be doubled and that milk production per cow could be raised 90 percent.

(11) The use of increased quantities of fertilizer represents the improved practice of greatest importance so far as yield increases are concerned. Eighty-one percent of the 208 "representative" farm operators from whom detailed practice data were obtained used fertilizer on cotton, but only 4 percent fertilized at recommended rates in 1941. Use of fertilizer on cotton has increased during the war, but there is still much room for improvement. Although 31 percent of the farmers interviewed applied fertilizer on corn in 1941, less than 3 percent applied the recommended amount. Most farmers applied 50 to 100 pounds of nitrate of soda, whereas recommendations specify 200 pounds of nitrate of soda or its equivalent.

(12) Through farm reorganization and the adoption of improved practices, net cash farm income on a small cotton farm (30 acres of cropland) could be raised from $170 to $664, assuming the same prices. If assumed post-war prices were obtained the level of income would reach $1,235. Proportionate increases could be obtained through reorganization of representative farms in other important size-type groups.

APPENDIX

Table 1. Prices used in computing financial summaries of representative farms, Shortleaf Pine Area of Mississippi.

	1937-41 average	Post-war assumed
	Dollars	Dollars
Prices received:		
Cotton lint, lb.	0.109	0.14
Cottonseed, ton	27.49	47.25
Corn, bu.	0.66	1.04
Oats, bu.	0.45	0.58
Sweetpotatoes, bu.	0.84	1.25
Milk, less hauling, cwt.	1.57	2.83
Butterfat, lb.	0.27	0.52
Eggs, doz.	0.19	0.26
Beef cattle, cwt.	4.94	7.79
Veal, calves, cwt.	6.76	9.00
Hogs, cwt.	6.40	9.34
Chickens	0.14	0,20
Prices paid:		
Cottonseed meal, ton	27.49	47.25
Corn, feed, bu.	0.66	1.04
Corn seed, bu.	1.00	5.00
Cottonseed, bu.	1.00	3.00
Oats, bu.	0.45	0.58
Mixed fertilizer, tons:		
6-8-4	29.83	29.83
5-10-5	29.92	29.92
0-14-7	24.22	24.22
Ammonium nitrate, ton	51.00	51.00
Superphosphate, 20 percent, ton	20.40	20.40
Muriate of potash, ton	39.48	39.48
Lime, ton	4.00	4.00
Mowing, hired, acre	1.00	1.00
Machinery expense, per crop acre	0.50	0.50
Cotton ginning, bagging and ties, per lb. lint	0.01	0.01
Combining oats, acre	3.00	3.00
Sweetpotato containers, bu.	—	0.10
Depreciation of mules	8.00	8.00
Depreciation of improvements per $100 of original cost	3.00	3.00

APPENDIX

Table 2. Man labor and power required per crop acre and per unit of livestock with normal and increased yields, Shortleaf Pine Area of Mississippi.

Item	Total hours		Distribution of man hours by months											
	Man	Mule	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
Crops:														
Cotton with normal yield	114.0	41.2	0.6	0.6	2.8	11.8	17.5	15.2	8.8	6.6	26.6	20.7	2.8	—
Cotton with improved yield	135.0	42.0	0.6	0.6	2.8	11.8	17.5	15.2	8.8	6.7	33.0	31.0	7.0	—
Corn with normal yield	34.4	34.7	—	0.5	5.0	6.2	8.4	8.1	1.2	—	—	3.5	1.5	—
Corn with improved yield	40.0	36.0	—	0.5	5.0	6.2	8.4	8.1	1.2	—	—	7.0	3.6	—
Cowpea hay	23.8	34.0	—	1.6	2.4	2.3	4.0	3.5	—	5.0	5.0	—	—	—
Lespedeza hay	14.6	22.0	—	2.0	4.2	—	—	—	—	2.2	6.2	—	—	—
Oats for hay	18.0	26.0	—	—	1.5	—	9.0	—	—	—	—	4.5	3.0	—
Oats for grain	10.5	18.0	—	—	—	—	3.0	—	—	—	—	4.5	3.0	—
Summer pasture	7.4	14.0	—	—	1.6	2.8	3.0	—	—	—	—	—	—	—
Winter pasture	4.0	8.0	—	—	—	—	—	—	—	2.0	2.0	—	—	—
Sorghum for silage	60.3	27.5	—	—	1.6	2.8	5.5	3.1	0.5	13.3	33.5	—	—	—
Sweetpotatoes	100.0	55.0	—	1.5	6.5	7.5	27.0	20.5	—	—	—	37.0	—	—
Livestock:														
Workstock	60.0	—	5.0	5.2	5.6	6.4	6.4	6.4	3.8	3.8	4.2	4.5	4.0	4.7
Milk cows	112.0	—	10.0	10.0	10.0	10.0	10.0	10.0	8.0	8.0	8.0	8.0	10.0	10.0
Beef cows	28.0	—	4.0	4.0	3.0	1.5	1.5	1.5	1.5	1.5	1.5	2.5	2.0	3.5
Other cattle	14.0	—	2.0	2.0	1.5	0.8	0.8	0.8	0.8	0.8	0.8	1.2	1.0	1.5
Sow and litters	78.0	—	6.0	6.0	8.0	8.0	7.0	6.0	5.0	5.0	6.0	8.0	7.0	6.0
Other hogs	16.5	—	1.5	1.5	1.5	1.5	1.5	1.3	1.0	1.0	1.3	1.6	1.5	1.3
Hens (50 per flock)	240.0	—	16.0	17.0	20.0	32.0	32.0	30.0	20.0	15.0	15.0	14.0	14.0	15.0

APPENDIX

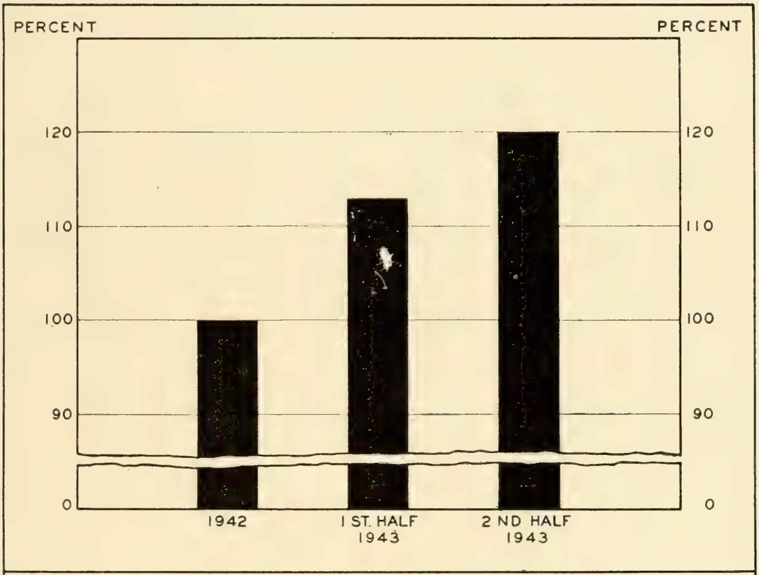
Table 3. Usual seeding rates for important crops, Shortleaf Pine Area of Mississippi.

Crop	Unit	Usual seeding rate[1]
Corn	Pound	8.0
Oats	Bushel	2.0
Cotton	Bushel	1.0
Peanuts	Pound	45.0
Soybeans for hay	Pound	60.0
Cowpeas for hay	Pound	48.0
Sweetpotatoes	Bushel	8.0
Lespedeza	Pound	25.0
Kudzu	Crown	500.0

[1] The recommended seeding rate is higher for most crops.

BULLETIN 406 JUNE 1944

RURAL LAND MARKET ACTIVITY
in
MISSISSIPPI



RELATIVE PRICES OF FARM REAL ESTATE IN MISSISSIPPI, 1942-1943
1942=100

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

Summary

The price of farm land in Mississippi has increased substantially since 1941. The rate of increase has varied for different sections of the State, but it appears that for the State as a whole, the rate has been slightly more than one percent per month during that period. The greatest increase has been in the Brown Loam Area. Indications are that the slight increase shown for the Delta Area was due to the fact that prices in this area had made a considerable advance in the years immediately preceding the period covered by this study.

Volume of sales of farm real estate has also increased materially since 1941. This has been true for practically all sections of the State. Farmers were the most important group in the market, both as buyers and sellers. Farmers purchased more tracts than they sold which indicates a relative increase in ownership by farmers.

Resales of land purchased since 1940 have been infrequent, but there was evidence that a considerable number of purchases have been made by farmers fo speculative purposes.

A high percentage of the total sales were financed with mortgages for more than half of the sales' consideration. The relatively large number of sales with mortgage indebtedness of more than 50 percent involved are significant in terms of inflationary tendencies and potential economic dislocations, should agricultural income be reduced in the post-war years.

The present situation probably cannot be described as acute inflation, but it is definitely an active and rising market. Whether a full-fledged boom materializes will depend largely on the general price and demand situation, the adequacy of labor and material supplies during the remainder of the war and the immediate period thereafter, and attitudes of the public generally toward farm land inflation.

Rural Land Market Activity In Mississippi

By DUDLEY E. YOUNG, MARVIN A. BROOKER and FRANK J. WELCH[1]

During the emergency war period the national income has risen materially as a result of higher prices for agricultural products and other raw materials and increased industrial employment and wages, while the volume of consumption goods has been shrinking. As a result, it is estimated that the national income is in excess of the current value of consumption goods after the payment of taxes by some 17 to 24 billions of dollars.

Improved agricultural income, together with the excess purchasing power indicated above and other economic influences, have tended to push prices of agricultural land up rather sharply during the past 3 years. This tendency toward rapidly increasing land values has disturbed many agricultural leaders because of the possibility that it may result ultimately in a disastrous land boom with all the evil consequences that inevitably go with greatly inflated land values.

Implications of Inflated Land Values

The welfare of agriculture as well as the general welfare is influenced very materially by the relative stability of agricultural land values that are closely related to net earnings of agriculture. The unpleasant memory of what happened following the last war as a result of inflated land values during the war period and post-war deflated agricultural prices should, and no doubt will, tend to hold land prices down somewhat.

An effort on the part of farm families to discharge farm mortgage debt obligations that are too high in relation to farm income, results in undue hardships and sacrifices on the part of farm families. In addition, such a situation usually results in poor farm management practices with reference to soil conservation and improvement practices. In fact, too often the soil is mined, repairs and improvements of all kinds neglected, and timber and other physical resources exploited in an effort to hold the equity already acquired in the land. Such sacrifices on the part of farm people and physical resources influence adversely the general welfare by curtailing normal farm purchasing power and by eliminating the basis for normal financial support of rural churches, schools and other institutions.

Inflationary Forces and Tendencies

This report is designed to indicate the present status together with trends as related to land values during the war period. It is difficult to say just when land values are inflated. Many factors influence the value of a particular farm, but in the long run, the value of agricultural land must bear a definite relation to the net income which it produces. From an investment opportunity viewpoint, the returns from farm lands over a period of years should be equivalent to returns from alternative investment opportunities. Farm operators should expect nothing less. When, however, farm operators have sunk capital in land and have acquired an equity in a farm home, many will not only forego all interest returns on invested capital, but will even sacrifice wage returns to themselves and families in order to protect the established equity when agricultural returns drop to low levels as related to land debt obligations.

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[1] Mr. Young is agricultural economist with the Bureau of Agricultural Economics, Atlanta, Georgia; Dr. Brooker is director of research, Farm Credit Administration, Fifth District, New Orleans, Louisiana; and Dr. Welch is head of Department of Agricultural Economics, Mississippi Experiment Station, State College, Mississippi.

As an illustration of the method of computing land values on the basis of capitalized earnings, a net annual income or rent of $4.00 per acre capitalized at 5 percent would amount to land value at $80 per acre. This is computed by dividing the annual interest rate into the annual net income or rent. The influence of other factors in determining individual farm unit prices should not be overlooked, but land values that get very much out of line with current and prospective net earnings will ultimately lead to economic difficulties such as are indicated above.

Forces Tending Toward Inflation

At the present time a number of forces and influences are tending toward increased land prices. Some of these may be briefly suggested as follows: (a) excess purchasing power over the total value of available consumption goods; (b) improved agricultural income that has accompanied the war effort; (c) the tendency to purchase agricultural holdings as a hedge against possible inflation; (d) government support prices of agricultural products with prospects for continuation of such programs; (e) the possibility of returning veterans with government financial assistance bidding up the price of land; (f) the purchase of farms for social, recreational, and possible tax reduction purposes, none of which are associated with net farm income.

Anti-inflationary Forces

On the other hand, forces are operating that tend to retard the upward trend of land prices. Some of these may be stated as follows: (a) current shortages of labor, farm machinery, and fertilizers; (b) memory of the disastrous consequences of the last boom; (c) expectation that agricultural prices will decline shortly after the war; and (d) the educational campaign being carried on by Federal and State agencies with reference to the very real dangers of the consequences of farm land inflation, especially that part of it that must be financed on long-time mortgage basis.

It is obvious that some of the inhibiting factors, such as current labor and material shortages, will be eliminated before the danger of a real land boom disappears. Hence, these factors should not be relied on too strongly as means for keeping the situation in hand.

An examination of the situation in Mississippi with a view to determining just what the trend has been, follows. Land values have reacted differently from area to area and even from community to community, and detailed information with reference to all the type-of-farming areas is not complete. The information available, however, is adequate to indicate the general trend of prices during the past 3 years.

Sources of Information

The Mississippi land market data presented in this publication were compiled by the Bureau of Agricultural Economics of Atlanta, and the Farm Credit Administration of New Orleans, and interpreted by these agencies cooperating with the Mississippi Agricultural Experiment Station.

The Bureau of Agricultural Economics has been conducting a nation-wide study of the rural land market for the past 2 years by studying, quarterly, all sales of farm land or potential farm land in selected counties. Two of these counties, Covington and Washington, are in Mississippi. They were chosen as being reasonably representative of conditions in the Lower Coastal Plain and Delta Areas, respectively. The acreage, date of sale, price, and type of financing each bona fide voluntary sale made since January 1, 1940, were secured from county records. Foreclosures and sales for taxes were not included. After securing this information, county agents, Agricultural Adjustment Administration officers, and other county officials were interviewed with reference to the classification of purchasers and sellers.

The Farm Credit Administration has

been gathering information through secretary-treasurers of National Farm Loan Associations and through Federal Land Bank appraisers. These individuals have filed quarterly reports beginning with the fourth quarter of 1941, in which data have been given for representative sales occurring in their territories. They have also stated their own opinions of the local land market condition. Additional information was obtained from the files of the Federal Land Bank of New Orleans.

Trends in Prices and Volume of Transfers

Volume

Both the number of transfers and acreage sold in Covington and Washington Counties were much greater in 1943 than in 1941 (table 1). In fact, the acreage transferred in Covington County in 1943 was 91 percent greater than in 1941. The increases in these counties followed very different patterns. In Covington County, a decided slump in the first of 1942, showed a greater volume of land transferred than the corresponding quarter in previous years. In Washington County a decided slump in the market was evident during the last three quarters of 1942. This disparity may be due to differences in type of farm organization and operational practices in these counties.

In Covington County, most transfers were of small units, either of family size or units with one to three tenant families. According to persons interviewed, some sales may have been caused by scarcity of labor or inability to supervise widely separated farms. However, buyers were readily found for these farms among tenants or nearby farm owners with a reasonably adequate labor force. In Washington County, where highly commercialized production is the rule, sales were of small, usually undeveloped tracts or of large plantations. During 1942 and the first part of 1943, the agricultural

Table 1. Number of transfers, acreage transferred, and price per acre, Covington and Washington Counties, Mississippi, 1st quarter 1941 through 1st quarter 1944.

Year and quarter	Covington County			Washington County		
	Transfers		Price per acre	Transfers		Price per acre
	Number	Acres	Dollars	Number	Acres	Dollars
1941:						
1st quarter	29	1,890	9.84	35	3,597	42.65
2nd quarter	6	678	10.72	6	3,835	45.72
3rd quarter	19	947	12.32	25	2,714	29.93
4th quarter	55	3,838	10.30	48	8,222	35.77
Total or average	109	7,353	10.48	114	18,368	38.33
1942:[1]						
1st quarter	23	1,743	10.49	21	11,011	24.99
2nd quarter	18	1,201	9.74	7	507	14.57
3rd quarter	11	1,628	5.01	7	306	46.00
4th quarter	68	4,264	12.95	30	4,874	37.21
Total or average	120	8,836	9.60	65	16,698	28.22
1943:						
1st quarter	44	4,749	9.16	39	8,915	43.98
2nd quarter	22	1,424	15.34	12	1,189	40.15
3rd quarter	45	3,278	14.66	37	7,693	45.70
4th quarter	63	4,618	13.95	60	9,636	54.65
Total or average	174	14,069	11.79	148	27,433	47.73
1944:						
1st quarter	42	2,634	14.93	24	3,211	87.15

Source: Bureau of Agricultural Economics, Atlanta.

[1] It is the concensus of opinion of informed persons in Washington County that farms sold in 1942 were of a lower value generally than those sold in 1941, 1943, and the first quarter of 1944.

Table 2. **Relative changes in the price of farm land in Mississippi from 1942 to 1943 by areas.**

Area	1942	1st half 1943	2nd half 1943
	Percent	Percent	Percent
Delta[1]	100	97	102
Brown Loam	100	133	132
Shortleaf Pine	100	99	123
Northeast Prairie	100	118	119
Lower Coastal Plain	100	110	126
State	100	112	120

Source: Division of Research, Farm Credit Administration of New Orleans.

[1] The small percentage increase in the Delta may be due to the fact that land prices had increased sharply prior to 1942. (See figure 2).

situation was extremely unsettled. It seemed probable that shortages of labor, fertilizer, and machinery would be even more severe than they have since proved to be. Consequently, in the plantation area, the land market was rather dull for the last three quarters of 1942. Beginning in the fall of 1943, however, the land market took on a new activity due to the fact that the labor situation was not as bad as had been expected and future prospects were more promising.

Reports from secretary-treasurers of National Farm Loan Associations and Federal Land Bank appraisers indicate that similar increases in volume have occurred in most sections of the State. For the State as a whole, land market activity has increased since 1941.

Price Per Acre

The variations in price per acre in Covington and Washington Counties have been somewhat erratic, due, at least in part, to changes in the proportion of improved and unimproved lands which have been transferred. The trend, however, is definitely upward. In Covington County the average price per acre was above $12.00 in one quarter of 1941, in one quarter of 1942, and in three quarters of 1943 (table 1). In Washington County the average price was evidently influenced considerably by the type of land transferred. If comparison is limited to those quarters in which more than 4,000 acres of land were bought—the fourth in 1941, the first and fourth in 1942, and the first, third, and fourth in 1943—the trend is definitely upward ranging from a low of $24.99 per acre in the first quarter of 1942 to $54.65 per acre in the fourth quarter of 1943.

Comparison of these prices with those paid in Crittenden County, Arkansas. and Madison Parish, Louisiana, corroborates the trend shown by Washington County In Crittenden County (a Delta county which has a high proportion, 76.7 per cent, of its land in farms[2]), prices have risen from $48.65 an acre in 1941 through $56.14 in 1942, to $60.16 in 1943. and $90.63 in the first quarter of 1944.[3] In Madison Parish, Louisiana (a county with much undeveloped land, only 39.9 percent in farms[4]), prices have also risen steadily, from $11.33 an acre in 1941, to $23.88 in 1942, and $28.52 in 1943.[5]

Data for the different areas in the State (figure 1) show that increases in price computed from actual sales have been general. A comparison of the last half of 1943 with the whole of 1942 shows that these increases have ranged from 2 percent in the Delta to 32 percent in the Brown Loam Area (table 2). A weighted index based on the total crop acreage in each area shows an increase for the State of 20 percent in price from 1942 to

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[2] Census, 1940.

[3] Bureau of Agricultural Economics, unpublished data, "Farm Land Market Activity in the South Central Region, First Quarter, 1944," prepared by Max M. Tharp, February, 1944.

[4] Census, 1940.

[5] BAE, unpublished data, **op. cit.**

Table 3. Percentage increase in value per acre of farm land sold by quarters as compared with its estimated value a year earlier, Mississippi, 4th quarter 1941 through 1st quarter 1944.

Year and quarter	Number of transfers	Percentage[1] increase
1941:		
4th quarter	100	20
1942:		
1st quarter	75	18
2nd quarter	69	31
3rd quarter	68	24
4th quarter	347	20
1943:		
1st quarter	268	19
2nd quarter	162	15
3rd quarter	236	15
4th quarter	318	14
1944:		
1st quarter	244	15

Source: Division of Research, Farm Credit Administration of New Orleans.

[1] Based on estimates made by secretary-treasurers of National Farm Loan Associations, during the quarter when land was sold.

the last half of 1943. For the State as a whole, prices in each quarter from the fourth quarter of 1941 through the first quarter of 1944 have been higher than the estimated value of these properties for the same quarter of the previous year (table 3). The increase has ranged from 31 percent in the second quarter of 1942 to 14 percent in the fourth quarter of 1943.

Resales of identical tracts of land are one of the best sources of information on price trends, because in these sales the influence of changes in the quality of land transferred may be disregarded without fear of serious error. Eighteen tracts previously purchased during the period studied were sold in Covington and Washington Counties in 1943. The 8 tracts in Covington County were resold for 13 percent more than their purchase price, while the 10 tracts in Washington County were resold for an increase of 31 percent (table 4).

Historically, the price of farm land in Mississippi has closely followed the price of cotton (figure 2). The prices of farms in the Mississippi Delta increased to considerably greater heights in 1920 compared with the 1912-14 level than did the price for the whole State. The responsiveness of Delta land prices to the price level of cotton may be explained, at least in part, by the intensive method and

Table 4. Resales of properties bought since January 1, 1941, and sold again in 1943, Covington and Washington Counties, Mississippi.

Item	Covington County	Washington County
Resales—number	8	10
Total land in tracts—acres	688	2,167[1]
Total consideration (original sale)	$5,145.00	$101,004.00
Price per acre (original sale)	7.48	46.61
Total consideration (resale)	5,830.00	133,994.00
Price per acre (resale)	8.47	61.07
Increase in selling price—percent	13	31

Source: Bureau of Agricultural Economics, Atlanta.

[1] Resold as 2,194 acres due to new surveys.

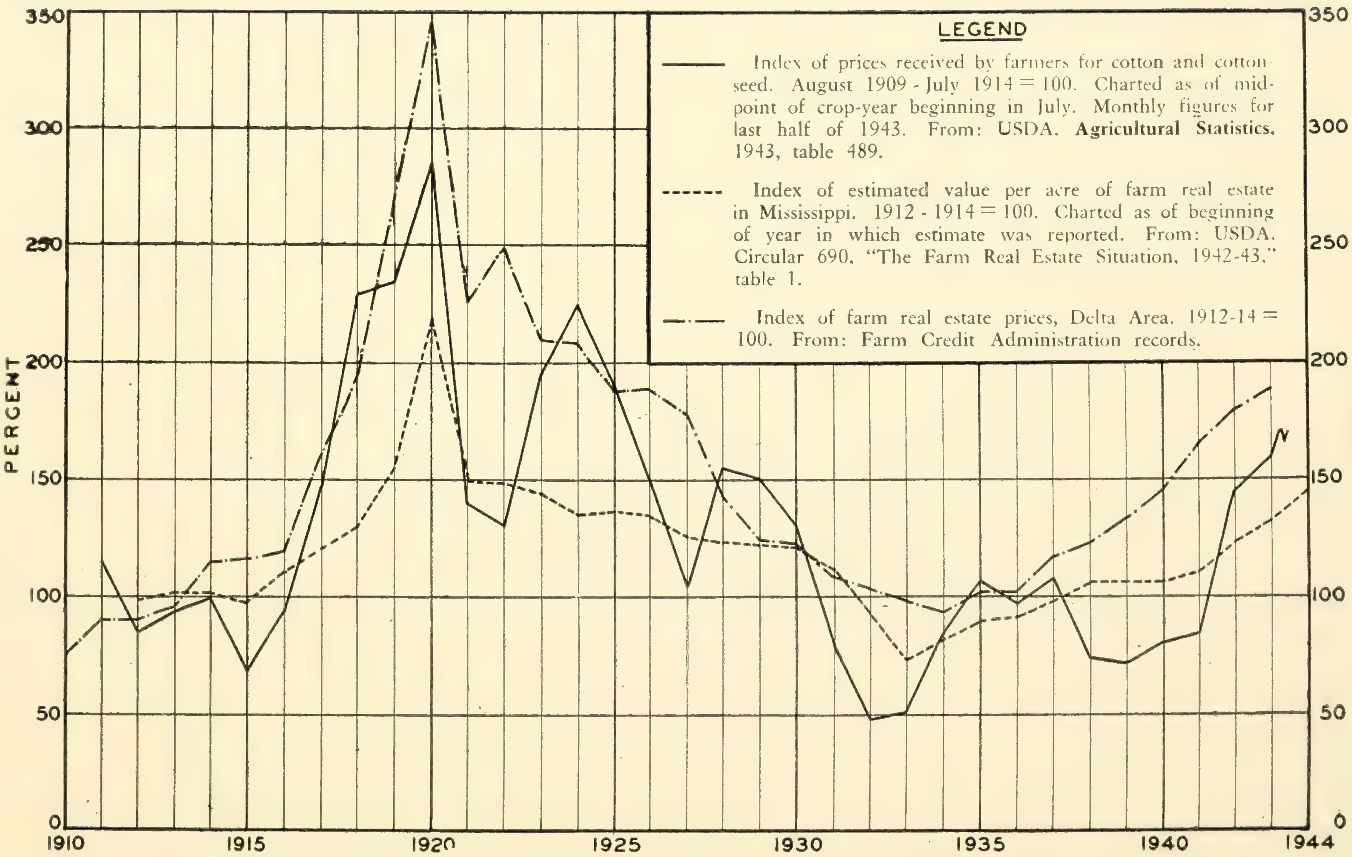

Figure 2. Comparison of indices of prices received by farmers for cotton and cottonseed and estimated value per acre of Mississippi farm real estate.

importance of cotton production there. The lack of response to rising prices for cotton in 1923 and 1924 may be accounted for by severe insect damage to the crop in the years 1920 through 1923. In these years information indicates that insect damage decreased yields by varying amounts from 24 percent in 1920 to 35 percent in 1921.[6]

The parallel between the 2 years of United States' participation in World War I and the 2 years since 1941 is significant. The close correlation between land and cotton prices in Mississippi is natural since cotton is the main source of income for most Mississippi farmers.

All of the price data presented above show upward trends. One point of view that has been publicly advanced is that the value of farm lands did not recover from the depression and was considerably lower than might be expected on the basis of returns to farmers in the prewar period, 1935-1939. The land value and cotton price indexes presented in figure 2 do not support this argument. The land value index for the State shows. on the contrary, that prices varied from 90 in 1935 to 106 in 1940, using 1912-1914 prices as 100, while cotton prices varied from 96 in 1935 to 84 in 1940.

For any long period of time land prices in excess of 100 on this index cannot be regarded as normal unless it is anticipated that cotton and cottonseed prices will remain at a higher level than in the 1909-1914 period. Land values based on the assumption that cotton prices will remain on a high level during the post-war period may be unwarranted. The future of cotton is precarious and uncertain. The possibilities of production in competing areas in other parts of the world and the development of synthetic substitutes may influence materially both the level of production and the price of cotton in the United States. These factors should be given careful consideration by those who are purchasing land with the expectation that cotton is to be produced as the major cash crop in the post-war years.

County officials interviewed in Covington and Washington Counties have been unanimous in stating that the scarcity of labor has been a severe restraining influence on land prices. Other factors mentioned are scarcity of machinery and memory of the land boom of the last war. It is noticeable, however, that this last reason appears to be given less importance in recent interviews than it was in the early part of 1942. The price data already cited indicate that the inhibiting factors may be having less effect than is commonly thought and that actually inflation is proceeding at approximately the same rate as during the first 2 years of the first World War. Certainly there is every reason to believe that the shortage of machinery will be relieved within a short time after the European war stops. The scarcity of labor should also be modified then. It is probable that inflationary tendencies will reach a peak at that time.

Higher farm income is the most important factor causing higher land prices. This rising farm income is demonstrated by the trend in the average gross cash income from farm marketings, excluding Government payments, which rose in Mississippi from $154,660,000 for the years 1935-39 to $268,122,000 in 1942 and $340,345,000 in 1943.[7] Farmers are not the only group with higher incomes. The rapid increase in deposits of Mississippi banks, from $271,335,513 on December 31, 1941, to $388,873,005 on December 31, 1942, and $485,947,807 on December 31, 1943, is a good indication of the increase in liquid assets.[8] While only a part of these funds will go into actual land purchases, they operate in two ways to increase land prices. First, they are a sign that many individuals have idle funds and some of these will put their

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[6] USDA, **Yearbook**, 1925, table 327.

[7] BAE Income Reports.

[8] "The Mississippi Banker," March, 1944.

Table 5. Number and percentage of mortgaged sales and buyers' equity in them, Covington and Washington Counties, Mississippi, 1st quarter 1941 through 1st quarter 1944.

Year and quarter	Covington County			Washington County		
	Mortgaged sales			Mortgaged sales		
	Number	Percentage of all sales	Buyers' equity[1]	Number	Percentage of all sales	Buyers' equity[1]
		Percent	Percent		Percent	Percent
1941:						
1st quarter	18	62	35	29	83	8
2nd quarter	4	67	46	3	50	34
3rd quarter	12	63	21	21	84	7
4th quarter	29	53	18	37	76	22
1942:						
1st quarter	13	57	35	15	71	10
2nd quarter	10	56	11	1	14	0
3rd quarter	5	45	46	4	57	30
4th quarter	38	56	27	25	83	12
1943:						
1st quarter	28	64	23	27	69	20
2nd quarter	10	56	38	11	92	18
3rd quarter	20	44	34	25	68	28
4th quarter	37	59	41	57	95	24
1944:						
1st quarter	22	52	31	18	75	39

Source: Bureau of Agricultural Economics, Atlanta.

[1] Cash payment as a percentage of consideration exchanged for all mortgaged sales.

money in land. Second, the banks themselves are likely to become more liberal in their lending policies as they accumulate a large amount of funds available for loans.

Methods of Financing

During the 13 quarters studied (the fourth of 1941 through the first of 1944) a high proportion of the transfers have been mortgaged. In Covington County more than 50 percent of the transfers have had mortgages in 11 of the 13 quarters. In Washington County 50 percent or more of the transfers were mortgaged in 12 of the 13 quarters. The median[9] was 56 percent in Covington County and 75 percent in Washington County (table 5). Buyers' equities were also low on mortgaged sales. In 10 of the 13 quarters the average buyers' equity in Covington County was less than 40 percent. In Washington County the average buyers' equity was less than 30 percent for 10 of the 13 quarters (table 5). These figures indicate that, insofar as the terms of sale are concerned, purchasers in Washington County are in a considerably less secure position than are those in Covington County. A high proportion of the credit-financed transfers in both counties had mortgages amounting to 50 percent or more of the consideration exchanged. In Covington County in 1943, 75 sales, or 43 percent of the total number, were mortgaged for 50 percent or more of the consideration involved. In Washington County (1943), 114 sales, or 77 percent of the total number, were mortgaged for 50 percent or more of their consideration (table 6). The FSA financed 32 of these Washington County sales (tables 7).

Sources

The composition of the lending group which financed mortgaged sales has changed somewhat since 1941 in Covington County. The seller has become less important as mortgagee. In 1941 the seller financed more than four-fifths of all mortgaged sales. Commercial banks financed a considerably greater proportion of the sales in 1943 than they did in 1941 (table 7).

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[9] Median: The middle item in a series of items arranged according to size.

In Washington County there was little change in the relative importance of various groups of mortgagees. The most noticeable difference between the two counties is in the much greater number of sales financed by the Farm Security Administration in Washington County (table 7).

In spite of the figures cited above, the total farm-mortgage debt situation of Mississippi farmers is quite favorable now as compared with that of the past 25 years. Farm mortgage debt has dropped from a peak of $146,556,000 in 1922 to $99,968,000 in 1943.[10]

Interest Rates and Mortgage Terms

Interest rates on mortgages are high in Covington and Washington Counties (table 8). During the last quarter of 1943 and the first quarter of 1944, almost all loans on which borrowers paid interest at rates below 4 percent were supplied by the Farm Credit and Farm Security Administrations.[11] In Covington County, the usual rate charged by other creditors was 6 percent, with 8 percent the second most important rate, Government agencies excluded (table 8). High interest rates are typical of the State and are not a wartime development. In March 1941, contract interest rates for farm mortgages in Mississippi payable to individuals averaged 6.0 percent; interest rates on loans payable to commercial banks averaged 7.2 percent.[12]

The term of mortgages in Covington

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[10] BAE, "Revised Annual Estimates of Farm Mortgage Debt by States, 1930-43," Horton, Donald C., and Umstott, Haven D., April 1944.

[11] Under legislation in effect during the period covered by this study borrowers were charged with interest at the rate of 3.5 percent on land bank and Commissioner loans.

[12] USDA, "Agricultural Finance Review.' Vol. 4, No. 2, November 1941.

Table 6. Number of credit-financed transfers classified by ratio of encumbrance to consideration, Covington and Washington Counties, Mississippi, January 1941 through March 1944.

Credit as a proportion of total consideation	Covington County				Washington County			
	1941	1942	1943	1st quarter 1944	1941	1942	1943	1st quarter 1944
Percent	No.	No.	No.	No.	No.	No.	No.	No.
Under 25	3	1	2	0	1	1	0	0
25 — 49	6	7	18	5	3	2	6	0
50 — 74	13	25	29	6	16	7	23	5
75 and over	41	33	46	11	70	35	91	13

Source: Bureau of Agricultural Economics, Atlanta.

Table 7. Number of new mortgages on land transferred, Covington and Washington Counties, Mississippi, January 1941 through March 1944.[1]

Type of mortgage holder	Covington County				Washington County			
	1941	1942	1943	1st quarter 1944	1941	1942	1943	1st quarter 1944
	No.	No.	No.	No.	No.	No.	No.	No.
Seller	42	44	54	7	50	28	75	13
Other than seller	10	12	26	10	36	13	48	3
Individuals	0	0	2	3	3	5	6	1
FLB and Commissioner	4	4	11	2	2	1	2	0
Insurance companies	0	0	0	0	1	3	2	0
Commercial banks	3	5	12	5	1	1	6	0
FSA	2	3	0	0	29	3	32	1
Other	1	0	1	0	0	0	0	1

Source: Bureau of Agricultural Economics, Atlanta.

[1] Mortgages include contract balance on recorded purchase contracts and bonds for title. Junior liens are included in this tabulation.

Table 8. **Interest rates on mortgages on land transferred, Covington and Washington Counties, Mississippi, 4th quarter 1943 and 1st quarter 1944.**

Item	Covington County		Washington County	
	1st quarter 1943	4th quarter 1944	1st quarter 1943	4th quarter 1944
	Number	Number	Number	Number
All mortgages	41	24	63	23
Mortgages for which interest rate is known	34	19	54	23
3.50 percent and less[1]	15	7	17	4
3.51 percent to 4.50 percent	1	1	3	4
4.51 percent to 5.50 percent	2	0	4	3
5.51 percent to 6.50 percent	11	7	29	12
6.51 percent to 7.50 percent	0	0	0	0
7.51 percent to 8.50 percent	5	4	1	0

Source: Bureau of Agricultural Economics, Atlanta.

[1] Federal Land Bank and Land Bank Commissioner loans were reported at 3.5 percent, the rate actually charged the borrower during this period. Contract rates for these loans are 4 and 5 percent, respectively.

County was extremely short. Of the 16 mortgages on transfers made in the first quarter of 1944 for which the term was known, only 4 were for 5 or more years. In Washington County the proportion of long-term mortgages during the same period was much greater. Half of the 20 mortgages for which the term was known were for more than 5 years, and an additional one-fourth were for 5 years. (See table 9).

Mortgage repayment plans in Covington County were divided almost equally between amortized loans in which principal and interest were combined into equal annual payments, loans with equal payments of principal each year and interest annually on the balance outstanding, and loans requiring a lump-sum repayment of all principal. In Washington County there were few cases of lump-sum payment; equal payments of principal with interest in addition was the most common arrangement. (See table 10). It was noted in the quarter studied (the first of 1944) that the only mortgages bearing equal annual payments were those of the Farm Credit Administration.

Types of Sellers and Buyers

Farmers became more and more important as sellers in the State between 1941 and 1943. The only other group of much consequence was individuals who were not farmers, since sales by estates and corporations declined. The decline in sales by corporations was due to a substantial decrease in the holdings of these owners rather than a lack of willingness to sell. The increasing importance of supervising operators as sellers between 1942 and 1943 is of signifi

Table 9. **Data on terms of mortgages on land transferred, Covington and Washington Counties, Mississippi, 1st quarter 1944.**

Item	Covington County	Washington County
	Number	Number
All mortgages	24	23
Mortgages for which term is known:	16	20
Due in 1 year or less	7	2
Due in 2, 3, or 4 years	5	3
Due in 5 years	1	5
Due in 6, 7, 8, or 9 years	0	2
Due in 10 years	0	1
Due in more than 10 years	3	7

Source: Bureau of Agrcultural Economics, Atlanta.

Table 10. Data on repayment plans of mortgages on land transferred, Covington and Washington Counties, Mississippi, 1st quarter 1944.

Item	Covington County	Washington County
	Number	Number
All mortgages	24	23
Mortgages for which repayment plan is known:	20	23
Equal annual payments	6	6
Equal annual payments of principal with interest paid separately[1]	7	13
Lump-sum payment of principal with interest paid annually or not stipulated	6	2
Other[2]	1	2

Source: Bureau of Agricultural Economics, Atlanta.

[1] A variation of less than $10 in size of principal payments is considered an equal payment, because such variations are usually merely for the purpose of making a convenient division of principal.

[2] Includes repayment by other than annual installments, by unequal annual payments of principal which are not set up to compensate for unequal payments of interest, or by variable payment plans based on income.

ance, evidencing a willingness to sell by larger operators.

Farmers also increased in importance as buyers. A smaller percentage of purchases were made by non-farmer individuals in 1943 than 1941. Since more farmers are buying than are selling, the trend at present is away from absentee ownership.

Detailed information for Covington and Washington Counties shows that farmers sold 50 percent of the tracts in 1941 compared with 74 percent in 1943 in Covington County, and 44 percent in 1941 compared with 53 percent in 1943 in Washington County (table 11). Farmers bought 78 percent of the tracts in 1941 in Covington County and 85 percent in 1943. In Washington County they purchased 85 percent of the tracts transferred in 1941 and 93 percent in 1943 (table 11).

Land Price Control

The fear that increasing prices and activity in the farm land market will lead to an inflation of proportions similar to that during and following the first World War has led to considerable discussion of the possibilities for averting or halting such a boom. The advocates of land price controls for the war years have been more determined in their efforts as a result of increasing prices and incomes since our entry into the war.

The five principal measures for controlling land prices or reducing excess purchasing power in the land market that have been suggested are the following:

1. Credit controls which would limit the indebtedness on any farm to the amount outstanding on a given date or a fixed percentage of an approved "normal value" appraisal or the market value as of a particular date. This measure would apply to all credit with land as security on any sale taking place after the regulation becomes effective. For example, if credit has been limited to less than 50 percent of the consideration exchanged, the terms of sale would have been affected in 43 percent of the sales made in Covington County and 77 percent of those made in Washington County in 1943.

2. Taxation of gains made from resale of property. Such a tax would apply only where both purchase and sale took place within a defined emergency period, and the rate would decrease as the time between purchase and resale increased. If such a tax had been in effect during 1943 and had applied to all sales of property purchased since 1940, approximately 5 percent of the sales made in Covington County and 7 percent of the

Table 11. Classification of sellers and buyers of land transferred, Covington and Washington Counties, Mississippi, January 1941 through March 1944.

Item	Covington County				Washington County			
	1941	1942	1943	1st quarter 1944	1941	1942	1943	1st quarter 1944
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Sellers:								
Individuals:								
Farmers:	50	44	74	57	44	56	53	63
Farm-operators	50	38	55	52	43	48	24	17
Supervising operators	0	6	19	5	1	8	29	46
Non-farmers	30	35	10	29	19	20	37	25
Unclassified	2	2	3	2	2	1	1	0
Estates	5	8	8	7	18	6	4	8
Corporations and public agencies	13	11	5	5	17	17	5	4
Buyers:								
Farmers:	78	78	85	79	85	91	93	100
Owners-operators	35	41	44	31	10	28	17	13
Supervising owners	5	9	8	2	32	18	29	29
Tenants	34	27	32	41	36	43	46	54
Others	4	1	1	5	7	2	1	4
Non-farmer individuals	19	15	11	21	15	6	7	0
Corporations and public agencies	3	2	1	0	0	3	0	0
Unclassified	0	5	3	0	0	0	0	0

Source: Bureau of Agricultural Economics, Atlanta.

sales made in Washington County would have been subject to the tax.

3. Taxation of all transfers. A Federal stamp tax on all transfers where the declared value is more than $100 is now in effect, but is at a low rate—55 cents for each $500. It is contended that if a tax of 10 to 20 percent of the consideration were enacted, it would serve to decrease the number of transfers.

4. Price ceilings and restriction of purchase by a permit system. Each tract would be appraised at "normal value" before sale, by Federally licensed appraisers or their equivalent. As there would usually be more than one potential buyer for each tract at the price set, permits to buy would be issued by local boards on the basis of desirability of the type of tenure and operation planned.

5. A method for indirectly influencing speculative land prices has been suggested. This would require that a portion of the sales price of all agricultural lands be paid for with government bonds during the emergency war period. Such bonds would be non-negotiable and nontransferrable for the duration of the emergency except in cases of distress. It is contended that such a measure would tend to reduce the volume of purchasing power and drain off excess funds that might otherwise remain in the hands of investors to be used in contributing to the general inflation. It should be noted that this measure would be of no aid to the purchaser of a tract. It would operate to remove investment funds from the market and this would probably have some retarding effect on prices.

The principal arguments presented by the advocates of some means of control are as follows:

1. Land values have increased and are continuing to increase at such a rate that a land boom is imminent unless restrictions are imposed.

2. The welfare of agriculture and the public requires that some method of effective control be enacted now.

3. Greatly increased land values now would immeasurably complicate post-war agricultural problems.

4. Unless some method of control is enacted now, a considerable proportion of farm land may be purchased by ab-

sentee owners, which is inconsistent with the American ideal of owner-operated farms.

5. Stabilized land values would contribute much toward the establishment of a desirable post-war national economy.

6. Speculation in agricultural lands makes no contribution to the economy but many social and economic evils flow from such speculation which would justify the public in taking steps to control or eliminate it.

In general, these arguments assume the desirability of controlling inflation, the implications of which have been mentioned previously, and are directed at showing that inflation is on the way and therefore controls should be enacted immediately.

On the other hand, the application of these or other methods of control does not meet with universal approval. Opposition to controls is based on the following arguments:

1. Land values are not inflated now and it should not be assumed that inflated values will result from the recent moderate increases in land prices. These increases have occurred because land prices at the beginning of the war were below the level justified by commodity prices as a result of the previous long depression and deflationary period.

2. Any effective controls would be extremely difficult to administer and would involve an undesirable expansion of bureaucratic activity.

3. Some of the controls advocated would unnecessarily penalize older farmers who are ready to retire, many of whom struggled desperately through the depression in an effort to pay for farm land.

4. Certain controls would discourage and make more difficult the purchase of farm land by tenants, young persons, and others with small capital resources who wish to become farm owners. These controls would also tend to increase tenancy and absentee ownership.

5. Controls are unnecessary since the gains and losses from fluctuating land prices tend to balance. Since the transfer of much farm land is among farmers, what one group loses, the other group gains.

6. Controls are unnecessary if farmers and other purchasers of land are informed as to the economic factors involved in the determination of land values and trends in land prices. No one can say what current land values should be because land values depend on future income, and no one knows what the general price and economic situation will be in the post-war years.

7. Land price controls would merely divert excess purchasing power to other channels and would not serve to decrease inflationary tendencies in general.

8. The land ownership pattern needs to be dynamic and a system of controls would decrease its flexibility. The purchase permit system would be particularly rigid.

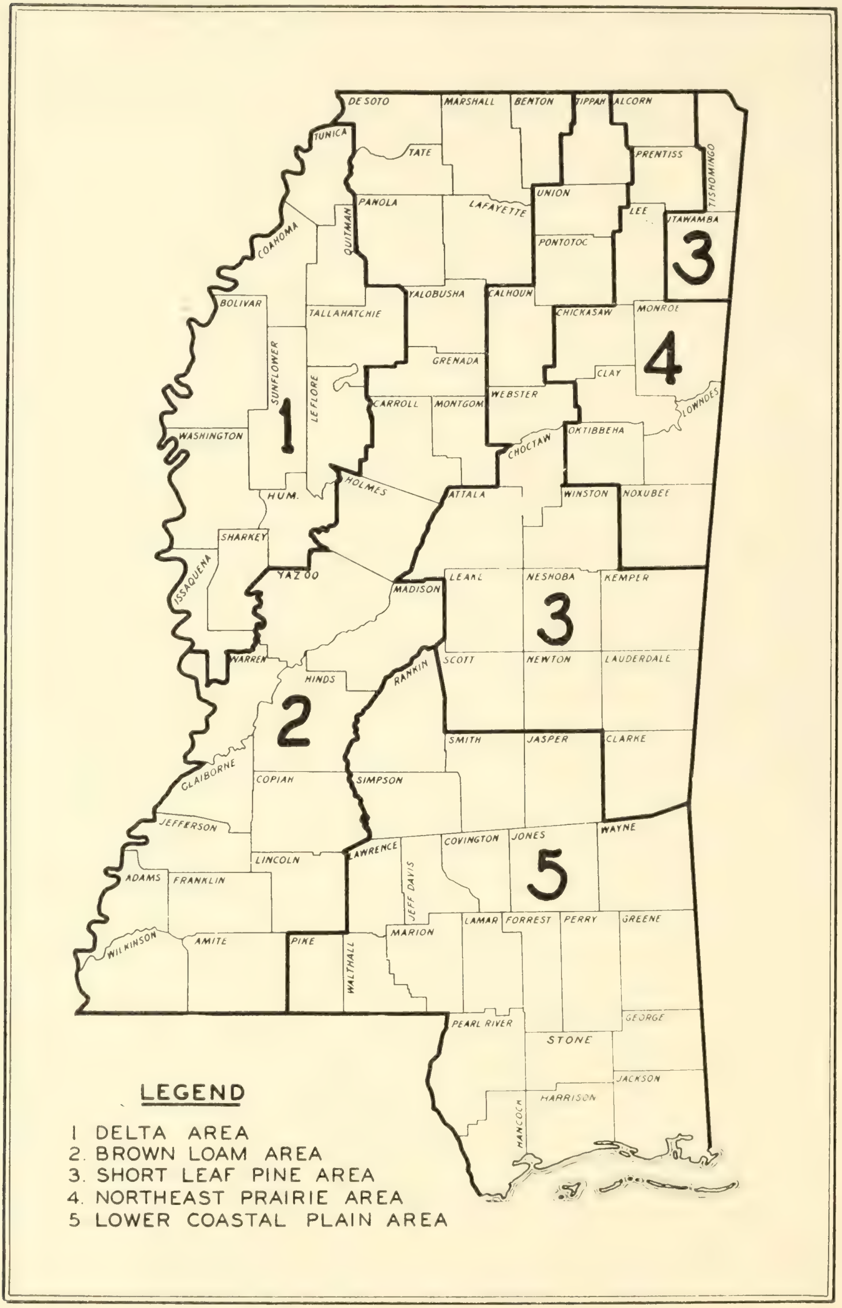

Figure 1. Areas by which data on land price trends is tabulated.

BULLETIN 407 JUNE 1944

Saving Minerals and Vitamins in Fresh Vegetables and Fruits

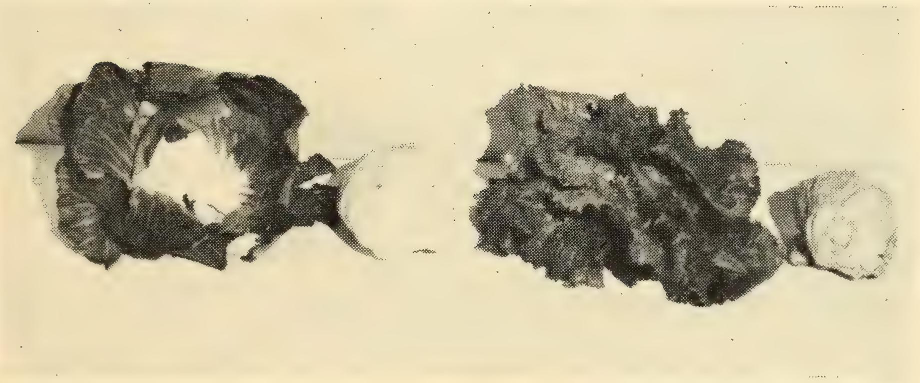

Figure 3. The outer green leaves of cabbage and lettuce are 2 to 4½ times richer in iron, 4½ times richer in calcium, twice as rich in vitamin C, and 30 to 40 times as rich in vitamin A as are the inner bleached leaves.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
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Saving Minerals and Vitamins in Fresh Vegetables and Fruits

By OLIVE SHEETS, Department of Home Economics

Our Government tells us that prewar "surpluses" of food have disappeared, that for the duration of the war and probably for a longer period, there will not be enough food for every one. While the people in this country will not lack for food and will be much better fed than those of any other country in the world, we are urged not to waste any food. In this way we shall have more for ourselves and our armed forces and more to share with other countries, who because of war conditions, have not been able to produce or purchase enough food, and many of whose people are on the verge of starvation.

A government handbook on the conservation of food[1] states that the avoidance of food waste is of "tremendous importance" and gives us the following facts. According to the U. S. Department of Agriculture, 20 to 30 percent of the food produced in the United States last year was wasted. This amounted to more food than was needed by our armed forces and for Lend-Lease requirements of all our allies.

It was estimated that one-fourth to one-third of the 125 millions of pounds of food which we waste every day could be saved in the home. Garbage studies made in 247 cities revealed that garbage contains an average of 300 pounds of food per person per year, 225 pounds of which was edible before it was thrown away. Of this, 100 pounds per person was wasted in the home.

The housewife, therefore, has a very important responsibility in preventing food waste. How can she do her part? By careful planning and buying, proper storage and preparation of food, and the prevention of waste at the table. All of these are necessary in conserving food, but we are especially concerned with storage and preparation, because they can result in large losses of food nutrients. Fresh vegetables are allowed to stand around in a warm place. Edible parts of vegetables and fruits are thrown away before they reach the table; nutrients which might be saved are lost in cooking; and vegetables are so poorly prepared that they are not eaten.

As many of us know, our best sources of minerals and vitamins are fresh vegetables and fruits. When they are not properly stored or prepared, both minerals and vitamins are lost. Yet, aside from animal protein, these are the nutrients for which we pay the most when we have to buy them, and, therefore, the nutrients most apt to be lacking in deficient diets. A realization on the part of the patriotic housewife of what she may be wasting when she prepares vegetables and fruits would do much to change her practices.

Saving Minerals and Vitamins in Vegetables

Saving by Proper Storage

Storage is an important step in the preservation of flavor, the prevention of waste, and the loss of nutrients of vegetables. If they are poorly stored, portions which might have been eaten will have to be thrown away. In addition, the part that remains may have lost much of its flavor and some of its food value. Many amateur victory gardeners will continue to grow gardens because they have learned how much better fresh vegetables taste. They are also getting more vitamins in their vegetables. If, however one must store green vegetables before they are used, proper storage will do much to keep them fresh.

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[1] The Conservation of Food, War Administration, in cooperation with the Office of War Information, March 1944.

Most green vegetables, particularly leafy vegetables, are rich in vitamin C; and since this is the vitamin which is most easily destroyed, the amount that remains after storage may well serve as an index to their freshness. Cooperative studies on the vitamin C content of stored turnip greens and lima beans (butter beans) have been made by the Home Economics, Chemistry, and Horticulture Departments of the Mississippi Experiment Station, working with other Southern experiment stations.

Turnip greens. Two methods of storage were used for two varieties of turnip greens—room and refrigerator storage for 24 hours. In room storage the greens were placed in paper bags or in baskets and allowed to stand in the laboratory In refrigerator storage the same kind of containers were used and the greens were held at about 40°F. Both fresh and stored samples were analyzed for vitamin C. The average vitamin C content for each of the two varieties before and after storage is shown in figure 1. As may be seen, both varieties of greens lost only a small part of their vitamin C when stored in the refrigerator, but when stored in the room a much greater loss occurred; Shogoin greens losing about one-fifth and Seven Top greens one-third of their original vitamin C value. The loss of vitamin C resulting from poor storage was not studied for other leafy vegetables, but investigators at the University of Arizona have found that in dehydration turnip greens retained their vitamin C content much better than spinach, swiss chard, or beet greens. It seems probable, therefore, that other leafy vegetables when poorly stored may lose more of their vitamin C than do turnip greens

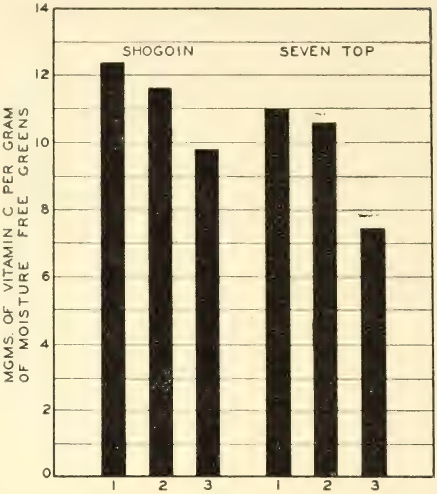

Figure 1. Vitamin C content of two varieties of fresh turnip greens and those stored by good and poor methods.

1. Vitamin C in fresh greens.
2. Vitamin C in greens stored 24 hours in refrigerator.
3. Vitamin C in greens stored 24 hours in room.

Lima beans. The storage experiments on lima beans were carried out on two varieties—pole and bush beans. The beans were stored both shelled and in the pod. The shelled stored beans were placed in the refrigerator (at about 40°F) and in the room for 48 hours, and the pod stored beans in the refrigerator and in the room for 96 hours.

As in the case of turnip greens, the results on the two varieties of beans were comparable. It was simpler, therefore, to average the two sets of data in the more complicated lima bean experiments. Figure 2 shows the average vitamin C content of the fresh and stored beans. Both the shelled stored and the pod stored beans retained much more of their vitamin C when kept in the refrigerator. The average loss of vitamin C for the shelled beans was 19.7 percent and for the beans in the pod 22.9 percent when

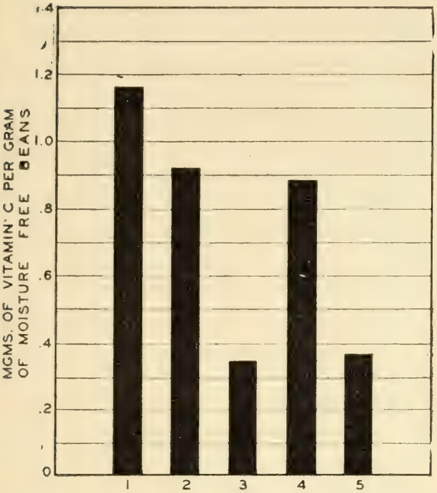

Figure 2. Vitamin C content of fresh lima beans and those stored by good and poor methods.

1. Vitamin C in fresh beans.
2. Vitamin C in beans stored 48 hours in refrigerator.
3. Vitamin C in beans stored 48 hours in room.
4. Vitamin C in beans pod-stored in refrigerator 96 hours.
5. Vitamin C in beans pod-stored in room 96 hours.

stored in the refrigerator. The corresponding losses for the room stored beans were 69.3 percent and 68 percent.

Thus the room stored beans lost over three times as much vitamin C as those stored in the refrigerator. The pod stored beans contained about the same amount of vitamin C as the shelled stored beans, yet were stored twice as long. It is evident, therefore, that beans stored in the pod lose less vitamin C than those stored shelled, whether they are kept in the refrigerator or at room temperature. This agrees with results obtained by investigators at Cornell University who found that peas (English) and lima beans retained vitamin C much better when left in the pod than when shelled.

Because of losses resulting from poor handling of vegetables, including storage losses, the housewife who buys all of her food at the market has an added responsibility. Not only must she store fresh vegetables properly in order to prevent losses, but she must also use care in their selection, or she will bring home vegetables from which much has already been lost. Thus, the Arizona investigators found on analyzing fresh spinach that one lot which came from the local market and was wilted and badly bruised contained only 5 milligrams of vitamin C per 100 grams, while another lot obtained from a home victory garden and analyzed soon after picking, contained 135 milligrams, or 27 times as much. Data on the vitamin C content of fresh spinach indicates that the difference between the two lots of spinach was largely due to loss of vitamin C on the part of the market spinach. The results of storage experiments show that it is best to buy all podded vegetables in the pod. The condition of the pods is also an important indication of the freshness of these vegetables.

Saving by Using Edible Parts

Frequently edible parts of vegetables—often the most nutritious parts—reach the garbage pail instead of the table. These parts include the outside leaves of head lettuce and cabbage, green tops of vegetables, leaves of celery, broccoli, and cauliflower, and the green tops of onions. Customs vary in households as well as in different sections of the country. Thus, some housewives use the stems and midribs of leafy vegetables; others throw them away. The majority of households in the North and West use only the roots of turnips, while those in the South use only the roots of beets, yet the leaves of vegetables are always more nutritious than the roots.

A knowledge of the nutritive value of

the various parts of vegetables which may or may not be eaten is therefore needed. The Home Economics Department of the Mississippi Experiment Station has made iron analyses of edible parts of a number of vegetables, including roots and tops of turnips, bulbs and tops of onions, outside and bleached leaves of lettuce and cabbage, and the stems, midribs, and leafy portions of several vegetables. There is also some information in the literature on the mineral and vitamin content of various parts of vegetables.

Minerals. Table 1 shows averaged data on the iron, calcium, and phosphorus content of edible parts of fresh vegetables. Other essential minerals have not been included, because, according to our present knowledge, they are seldom lacking in ordinary diets.

As will be noted from the table, the outer leaves of lettuce and cabbage are much richer in iron and calcium than the inner leaves. Thus the outer green leaves of lettuce contain twice as much iron and those of cabbage four and a half times as much as the inner bleached leaves, while the calcium content of the outer leaves of both vegetables is over four and a half times that of the inner leaves.

Information was lacking on the phosphorus content of the outer and inner leaves of head lettuce, but the outside leaves of cabbage contained a little more phosphorus than the inner leaves.

Beet and turnip tops were as superior to the roots with respect to iron and calcium as were the green leaves of head lettuce and cabbage when compared to the bleached leaves. The leaves of beets were more than three times and those of turnips four times richer in iron than the roots. The differences in calcium were even greater since the leaves of beets and turnips contained five and six times more calcium, respectively, than the roots. There was no difference in the phosphorus content of leaves and roots of beets, but the leaves of turnips contained over twice as much calcium as the roots

Table 1. Iron, calcium, and phosphorus content of different parts of vegetables.

Vegetable	Fresh Weight		
	Iron	Calcium	Phosphorus
	Percent	Percent	Percent
Head lettuce			
Outer leaves	.0010	.099	—
Inner leaves	.0005	.028	—
Cabbage			
Outer leaves	.0018	.387	.06
Inner leaves	.0004	.092	.05
Beet leaves	.0032	.134	.04
Beet roots	.0009	.026	.04
Turnip roots	.0005	.051	.03
Turnip leaves (tops)	.0020	.301	.07
Leafy part	.0032	.306	.08
Stems and midribs	.0008	.179	.04
Mustard leaves			
Leafy part	.0035	—	—
Stems and midribs	.0004	—	—
Collards			
Leafy part	.0018	—	—
Stems and midribs	.0003	—	—
Green onions			
Tops	.0011	.064	.032
White bulb	.0007	.056	.044

As many housewives discard the stem and midribs of mature turnip, mustard and collard leaves, these portions and the remaining leafy portion were analyzed separately, in addition to analyzing the whole leaves. The stems and midribs were found to contain from one-fourth to one-eighth as much iron as the leafy portion. The stems and midribs of mustard and collards were not analyzed for calcium and phosphorus, but those of turnip leaves had a little more than half as much calcium and half as much phosphorus as the leafy portion.

Mineral analyses of other plants have shown that the leaves contained considerably more iron and calcium than the stems, but the phosphorus was distributed about equally between the leaf and stem. Green onion tops contained two-thirds more iron, a little more calcium but less phosphorus than the bulbs.

From the information above, it will be seen that if one throws away certain parts of vegetables, a large part of their mineral value is being wasted. For example, since outer leaves of cabbage and lettuce constitute one-third to one-half the total weight of the heads, it is evident that one-half to three-fourths of the iron, and more than half to four-fifths of the calcium is lost if the outer leaves are not used.

The tops of medium-sized beets and turnips make up about half the weight of the plant. When only the roots are eaten, about four-fifths of the iron and as much or more of the calcium in the plants is wasted.

Vitamins. Different plants or even the same kind of plant may vary greatly in vitamin content. A range of values is, therefore, frequently given in tables showing the vitamin content of vegetables. Values for the vitamin A and vitamin C in various parts of vegetables are given in table 2. It is evident that the green leaves are much the richest source of vitamin A and contain considerably more vitamin C than other parts of the vegetables. Yet the outer green leaves of lettuce and cabbage are seldom used and turnip tops are usually discarded in northern households, as are beet tops in southern households.

If the housewife realized that by throwing away the green leaves she is losing most of the vitamin A (perhaps enough to supply the daily needs of all the members of her family) and two-thirds or more of the vitamin C in the vegetables

Table 2. Vitamin A value and vitamin C in different parts of vegetables.

Vegetable	Vitamin A value International units in 100 grams	Vitamin C milligrams in 100 grams
Lettuce		
Green leaves	4,000	10
Head	100	5
Cabbage		
Green leaves	5,934	131
Bleached leaves	188	61
Turnip leaves	10,000 - 18,000	121 - 245
Leaf blade (includes midribs)	14,484	112
Stems	667	25
Roots	0 - 40	24 - 43
Beet leaves	1,115 - 4,966	15 - 24
Beet roots	0 - 100	6 - 22
Celery leaves	14,000	14 - 62
Celery stalks	600	4 - 9

she is preparing, she would find appetizing ways to use these parts.

Saving by Proper Cooking

Both minerals and vitamins are lost in cooking vegetables, but the amounts may be kept to a minimum by the use of good cooking methods. In boiling this means cooking the vegetables in a small amount of water just long enough to get them tender. Proper steaming or cooking in a pressure cooker or sauce pan also saves minerals and vitamins Large losses of nutrients in cooking vegetables, therefore, come under the head of needless waste.

Many studies on cooking losses in the preparation of vegetables have been reported including one on iron losses and a later one on vitamin C losses which were made by the Home Economics Department of the Mississippi Experiment Station. The latter was a part of the cooperative study to which reference has been made.

Minerals. Losses of minerals by good and poor cooking methods are illustrated by the Mississippi study on iron, some results of which are shown in figure 4 The vegetables were cooked by the methods given in table 3. These methods corresponded to those used by Mississippi housewives for the same vegetables. The cooking time and water used varied with the vegetable. Only the losses of iron in the boiled vegetables are shown in figure 4, as vegetables are more often boiled than steamed. In all five vegetables the losses of iron were greatest when they were cooked by poor methods; that is. boiled in the larger amount of water for a longer time. As the chart shows, in four of the five vegetables the losses were over twice as great.

Steaming caused smaller losses of iron than boiling by the better method (cooking in small amounts of water just long enough to get them tender), in four of the five vegetables. Turnip greens lost about the same amount of iron by either method, but collards lost 6.5, cowpeas 3.5, lima beans 2.0, and string beans 5.5 percent less iron when steamed. Collards and string beans lost the most iron for all methods of cooking. This may have been partly due to the fact that collards. since they are a strong flavored vegetable, were cooked in larger quantities of water than the other vegetables, and to the fact that string beans were cut into pieces. Other investigators have found that when vegetables are cut up and cooked in large amounts of water they may lose from one-third to two thirds of their iron, one-sixth to three fourths of their calcium, and one-fourth to two-thirds of their phosphorus. It is evident, therefore, that if minerals are to be conserved in cooking vegetables, they should be left whole when practical and cooked in a small amount of water or steamed. Since minerals are not destroyed in cooking, but are leached out into the cooking water, they need not be

Table 3. Good and poor methods used in cooking turnip tops, collards, cowpeas, lima beans, and string beans.

Vegetable	Quantity cooked ounces	Good methods			Poor methods	
		Boiling in less than enough water to cover		Steaming minimum time to get tender	Boiling in more than enough water to cover	
		Water	Time boiled		Water	Time boiled
Turnip tops	14	1 c.	1¼ hrs.	1⅓ hrs.	2½ c.	2½ hrs.
Collards	12	2 c.	1 hr.	1 hr., 5 min.	4 c.	2¼ hrs.
Cowpeas	10½	5/6 c.	1 hr.	1 hr.	1⅔ c	1½ hrs.
Lima beans	Boiled 13 Steamed 16	5/6 c.	½ hr.	½ hr.	2 c.	1½ hrs.
String beans	14	5/6 c.	1 hr.	1 hr.	2½ c.	2½ hrs.

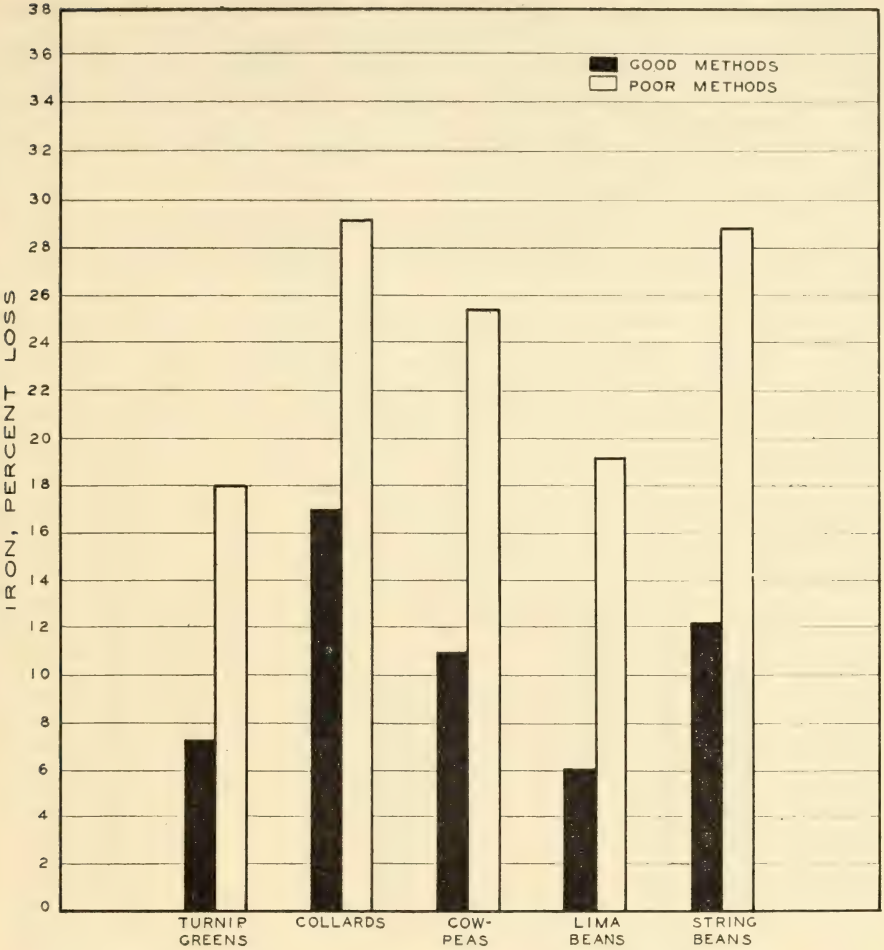

Figure 4. Losses of iron in vegetables cooked by good and poor methods.

lost if the water is used, but too often it is poured down the sink.

Vitamins. The use of good cooking methods is even more important in saving vitamins than in saving minerals, as large amounts of water soluble vitamins are not only leached out into the cooking water but may also be destroyed by poor methods of cooking. This is demonstrated by the cooking experiments to determine losses of vitamin C, which were a part of the cooperative study. Fresh and stored turnip greens and lima beans were boiled ½ hour and 3 hours and the percentage losses of vitamin C determined by analyzing the cooked vegetable and cooking water together. The results are shown in figure 5.

When turnip greens were cooked 3 hours, about two and a half times as much vitamin C was destroyed as when they were cooked ½ hour. The losses of vitamin C for lima beans were from two to almost four times as great for the 3

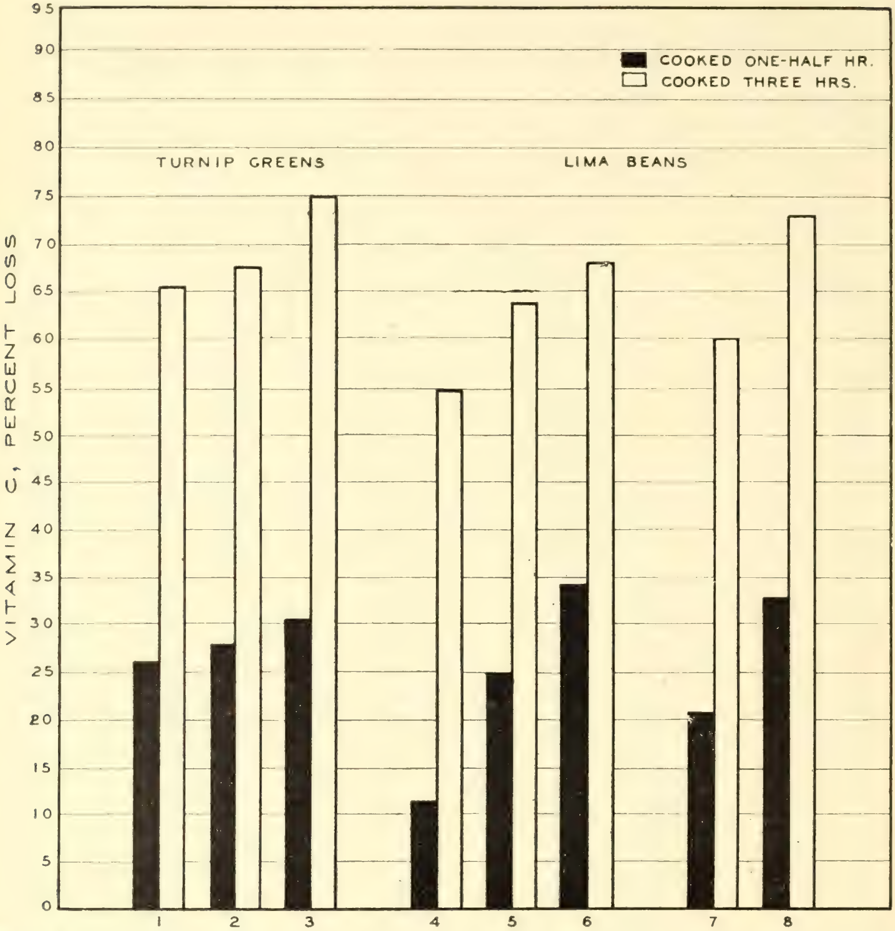

Figure 5. Percentage cooking losses of vitamin C in fresh and stored turnip greens and lima beans cooked ½-hour and 3 hours.

1. Fresh turnip greens.
2. Turnip greens stored in refrigerator 24 hours.
3. Turnip greens stored in room 24 hours.
4. Fresh lima beans.
5. Lima beans shelled and stored in refrigerator 48 hours.
6. Lima beans shelled and stored in room 48 hours.
7. Lima beans left in pod and stored in refrigerator 96 hours.
8. Lima beans left in pod and stored in room 96 hours.

hour cooking as for the ½-hour cooking.

These experiments also show that storage affects cooking losses. Thus the destruction of vitamin C in cooking was greater for the stored vegetables than for the fresh vegetables, and greater for those stored in the room than for those stored in the refrigerator. Another point brought out by the results is that the lima beans left in the pod and stored in the refrigerator for 96 hours lost less vitamin C when cooked than did the shelled beans stored in the same way for only 48 hours. It is evident, therefore, that good methods of storage help to prevent losses of vitamin C in vegetables when they are cooked.

Saving Minerals and Vitamins in Fruits

There is much less information on nutritive losses in fruits than on nutritive losses in vegetables. This may be explained in part by the fact that most fruits are less important sources of minerals and vitamins, with the exception of vitamin C, than are fresh vegetables. Moreover, proportionate losses of nutrients, especially vitamin C, are usually much smaller in fruits. There are a number of reasons for this. Many fruits, such as citrus fruits, apples, and melons, are less perishable than fresh vegetables, and are, therefore, more easily handled and stored. Then, fruits are acid, and vitamin C is better preserved in the presence of acid. Fresh fruits are less often cooked than fresh vegetables, and stewed fruits are cooked for a shorter time than are boiled vegetables. Also, the cooking water or sirup is not thrown away, but is served with the fruit.

Losses or waste of nutrients in fruits for which the housewife is directly responsible result chiefly from poor selection, poor storage, and failure to use all edible parts, although some cooking losses also occur.

Storage. Spoilage of fruit is the principal cause of storage losses, but storage also affects the loss of vitamin C. Fresh Bartlett pears contained 9 milligrams of vitamin C in 100 grams, but after refrigerator storage for 3 months, they contained only 3.6 to 5.1 milligrams. Apples of several varieties, when stored for 2 months at 32°F, lost from 12 to 47 percent of their vitamin C content. Since the original vitamin C content of pears and apples is not high, it is evident that they are a poor source of it when stored for several months.

Citrus fruits seem to retain their vitamin C much better than apples. Grapefruit and oranges stored for 1 month at 42°F. lost none of their vitamin C, and oranges stored at room temperature for 1 month retained most of the vitamin. Tomatoes resemble oranges in that they lose little vitamin C on storage. When held for 18 days either at refrigerator or at room temperature, there was no indication of loss. This is fortunate since tomatoes are our best source of vitamin C during the summer and fall when citrus fruits are scarce and expensive.

Berries also retain their vitamin C well on storage as long as they are sound, but crushed or injured berries lose vitamin C rapidly. For this reason they should not be capped if they are to be stored.

Use of edible parts. In all studies which have been made on the vitamin C content of different parts of fruits, including those of fruits commonly classed as vegetables, as peppers and tomatoes the skin or portion just under the skin has been found to be richer in vitamin C than the flesh. The peel of apples was found to contain over three and a half times as much vitamin C as the flesh, peach skins two to four times as much, and tomato skins one and a half times as much. The peel of oranges and grapefruit is also much richer in vitamin C than the juice. It has been reported to contain three to seven times as much. Unfortunately the only ways in which orange and grapefruit peel is ordinarily used are candied or in marmalade, since the raw peel is not palatable. Little of the original vitamin C of the fresh fruit remains in these sweets.

Not only is vitamin C lost in the peel, but much of it is wasted when the juice of oranges or grapefruit is strained, for the pulp may contain almost as much vitamin C as the juice. An economical way to serve these fruits is in segments. Studies at the University of Arizona show that this method of serving utilized 40 to 80 percent more of the vitamin C in the fruit than when the strained juice alone was served.

Losses in Preparation and Cooking

Preparation. Studies have shown that raw fruit prepared for serving and allowed to stand in the room may lose considerable vitamin C. Sliced bananas which stood 20 minutes lost one-eighth and those which stood 80 minutes more than one-fifth of their vitamin C. Apples which had been quartered, whether peeled or unpeeled, and allowed to stand 1 to 2 hours lost one-fifth of their original vitamin C content.

When preparing strawberries for the table it has been found that some loss of vitamin C may occur if they are hulled before they are washed. Slicing also conserves vitamin C better than crushing, and sugared berries retain vitamin C on standing better than unsugared berries.

Cooking. Few studies have been made on cooking losses in fruits. A study on apples showed that when baked they lost 80 percent of their vitamin C. Unstrained apple sauce lost 25 percent and strained apple sauce 32 percent of the vitamin C present in the raw apples Rhubarb retained most of its vitamin C when cooked, but the retention was better when the cooking vessel was covered than when it was left uncovered.

Summary and Conclusions

The prevention of food waste is of the utmost importance at the present time. A large share of the responsibility for saving food rests upon the housewife. She can do her part by careful planning and buying, proper storage and preparation of food, and the prevention of waste at the table. Of these, storage and preparation are of especial importance because they may result in large losses of food value.

Important nutrients which are lost when food is not properly stored or prepared are minerals and vitamins. Aside from animal protein, these are the nutrients for which we pay the most and, therefore, are most apt to be lacking in inadequate diets.

Our best sources of minerals and vitamins are fruits and vegetables. The Home Economics Department has carried out experiments on different methods of storage and preparation (including cooking) of vegetables in order to determine losses of vitamin C and of minerals. The results of other studies on both vegetables and fruits are also included in this report.

Storage is an important step in the prevention of waste in vegetables. Studies made by the Home Economics Department on vitamin C losses in fresh turnip greens which resulted from good and poor methods of storage showed that those stored 24 hours by a good method (refrigerator storage) retained most of the vitamin C, but those stored 24 hours by a poor method (room storage) lost one-fifth to one-third of their vitamin A.

In the lima bean experiments, both the shelled beans stored 48 hours, and the beans in the pod stored 96 hours in the refrigerator lost about one-fourth of the vitamin C which they originally contained. When the shelled beans were stored in the room 48 hours and the beans in the pod 96 hours, both lost about three times as much vitamin C as when stored in the refrigerator. Since the pod stored beans retained as much vitamin C as the shelled stored beans, although stored twice as long, it is evident that shelled beans when stored lose more vitamin C than those stored in the pod. This finding is confirmed by studies made at Cornell University on pod and shelled stored lima beans and English peas.

It may be concluded from the results of these studies that fresh vegetables which must be stored should be placed in the refrigerator, or as cool a place as possible, as soon as they are picked from the home garden or brought home from the market, and that it is best to buy and store podded vegetables in the pod.

In the preparation of vegetables in the household, edible parts are thrown away. Mineral and vitamin analyses made by members of the Home Economics Department and other workers have shown that when such parts as the outside green leaves of lettuce and cabbage, turnip tops or beet tops and other green leaves are discarded, one-half to four-fifths of the iron, an equal amount of calcium, nearly all of the vitamin A, and two-thirds or more of the vitamin C which the vegetables might have contributed to the family diet, is being wasted. The ingenious, thrifty housewife will find many ways of using the green leaves usually thrown away as those of lettuce, cabbage, celery, broccoli, cauliflower, or onion tops. She may use them in soups or cut them up in green salads, or they may be shredded and added to meat loaves and sauces to give added flavor as well as food value.

Other parts of vegetables not always used, as the stems and midribs of leaves, which have a much lower nutritive value than the part that is saved, may be discarded if there is a surplus of the vegetable that cannot be disposed of. This often happens when vegetables come from the home garden. Under these circumstances, the justification for discarding stems and midribs is that they serve to dilute the nutrients in bulky foods, they require longer cooking, and are less palatable. Since they do have some food value they should not be discarded if vegetables must be purchased at the market.

Proper cooking of vegetables is also important in saving minerals and vitamins. The Mississippi study on cooking turnip greens, collards, cowpeas, lima beans, and string beans showed that poor methods of cooking caused losses of iron which were over twice as great as good methods of cooking. Studies by other workers have shown that when vegetables are cut up and cooked in large quantities of water some of them lose most of their iron, calcium, and phosphorus. If, however, the cooking water or pot liquor is consumed the minerals are not wasted.

The use of good cooking methods is even more important in saving vitamins than in saving minerals, as vitamins are destroyed as well as being leached out into the cooking water. The Mississippi cooking experiments on fresh and stored turnip greens and lima beans showed that from two to four times as much vitamin C was destroyed when the vegetables were cooked 3 hours as when they were cooked ½ hour. The loss of vitamin C was greater in the stored than in the fresh vegetables, the room stored losing the most. The shelled beans stored in the refrigerator 48 hours lost more vitamin C than those in the pod stored twice as long. It is evident, therefore, that if cooking losses are to be reduced to a minimum, good cooking methods must be used and the vegetables should be as fresh as possible when cooked. If one has a garden it is best to pick vegetables just before they are to be cooked, but if storage is necessary they should be stored in the refrigerator or in a cool damp place.

When the housewife properly stores and prepares her vegetables, not only has she saved much of their food value, but she has also prevented further waste, because they are so palatable her family will leave little to be thrown away. Many more people would enjoy eating green vegetables if they were always fresh and well prepared when served.

Fewer studies have been made on losses of nutrients in fruits than on losses in vegetables. The probable explanation for this is that fruits are not as good sources of minerals and vitamins with the exception of vitamin C as are vegetables, they are more easily handled and stored, they are more often eaten fresh, and they lose less of their food value when stored or cooked. The principal losses of nutrients in fruits for which the housewife is responsible are caused by poor selection, poor storage, and failure to use edible parts.

Apples and pears have been found to lose from one-eighth to one-half of their vitamin C when stored 2 months. They do not, however, have a high vitamin C content. Citrus fruits and tomatoes which are excellent sources of vitamin C lose little on storage even at room temperature. Berries also retain their vitamin C well on storage as long as they remain sound, but when crushed or damaged lose it rapidly. They should not be capped when stored.

Much of the food value of fruits may be wasted when edible parts are not used. The skins of fruit, frequently thrown away, are much richer in vitamin C than the flesh. Apple peeling and peach and tomato skins contained from one and one-half to four times as much vitamin C as the flesh, while orange and grapefruit peel had three to seven times more than the juice. Much of the vitamin C content of citrus fruits is lost if the pulp is discarded. From 40 to 80 percent of the vitamin C in oranges and grapefruit may be saved if they are served in segments rather than as strained juice. It is to be hoped that some method may be found for preserving the vitamin C in the peel of these fruits.

It may be concluded that the best way to conserve the food value of fruits is to eat them fresh and whole whenever possible. At no time do they taste better and supply more nutriment than when picked ripe from the patch or the orchard and eaten on the spot.

Bulletin 408 September 1944

Production and Utilization of Hairy Vetch

BY

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Legumes may be harvested for hay or seed, or grazed, or turned under for soil improvement. Hairy vetch, the winter legume most widely grown in Mississippi, is utilized almost exclusively for soil improvement.

An investigation conducted by the Mississippi Agricultural Experiment Station in cooperation with the Tennessee Valley Authority sought to more definitely determine practical answers to questions farmers are asking, relating to the production of vetch, the utilization of vetch produced, and the place of vetch in the farming program.

The experiments were conducted over periods of 4 and 5 years, at 4 locations, and on several soil types. Some of the results are summarized below.

1. Contrary to the somewhat prevalent belief that vetch "plays out" or decreases in yield after a few years, vetch yields in most of the experiments were greater in the last 2 years than in the first 2 years.

2. Since phosphorus increased the yield of vetch much more than did potash or lime, phosphorus was indicated as the fertilizer principally needed for maximum vetch production. In a long-time vetch program a more acute need for potash and lime may develop.

3. In a rotation of cotton and vetch, little difference was noted whether the 0-8-4 fertilizer was applied to the vetch or to the cotton. That is, the fertilizer required by both vetch and the following crop of cotton, may be applied either to the cotton or the vetch.

4. When vetch is removed for hay and the roots and stubble turned under, soil building benefits nevertheless occur. Removal of the first crops of vetch as hay did not materially reduce the yield of the following crops of cotton when compared to cotton supplied with commercial nitrogen. However, continued removal of vetch did reduce yields of following crops of cotton.

5. Nitrogen supplied by vetch turned under produced a yield in the following crops of cotton almost equal to the yield of cotton which did not follow vetch but which received 200 pounds nitrate of soda (32 pounds actual nitrogen.) A good crop of vetch turned under was therefore approximately equal to 200 pounds of nitrate of soda or 100 pounds ammonium nitrate.

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Legumes are widely grown throughout Mississippi, summer legumes largely for hay or grain or other direct utilization, and winter legumes largely for soil improvement. There is no doubt a place in Southern agriculture for many legumes for use as cover to prevent erosion, for grazing, hay, and seed crops, and as soil builders.

Hairy vetch is perhaps grown on more acres than any other winter legume and in comparable quantities with most of the summer legumes, and its use is increasing from year to year. Its popularity is attributable to its ability to establish stands, to withstand unfavorable weather conditions, to resist disease, to produce good crops of green manure year after year. Numerous experiments have shown hairy vetch to be as good as, or better than, any other legume when turned under and measured by the following crop of corn or cotton.

Many farmers and agricultural workers think of vetch only as a soil builder, and ordinarily it is used for that purpose only. Vetch can be used, however, for grazing and hay. Perhaps vetch is not so good for grazing as some of the winter clovers, but livestock of all kinds will graze it and do well, especially during the early stages of vetch growth. Vetch hay is of excellent quality and is relished by most livestock. The amount of hay per acre produced compares favorably with that produced by other winter legumes.

Perhaps one of the greatest hindrances to the use of vetch is the expense of obtaining seed. So far, very few farmers have been able to grow and save their own seed, and the out-of-pocket cost of northern-grown seed has somewhat limited the amount of vetch grown on Mississippi farms. Then, too, the small number of farms in the hill section having necessary equipment for turning a good crop of vetch is also a somewhat limiting factor. Many farmers have been discouraged because of vetch failures. In many cases the farmers themselves are responsible for poor crops of vetch. There is no reason why there should be any more failures with vetch than any other crops, even cotton or corn, because there is but one factor that cannot be controlled by man, and that is weather conditions. This one factor may cause failure of any crop regardless of man's attention.

To secure factual data concerning the production and utilization of vetch, the Mississippi Experiment Station, in cooperation with the Tennessee Valley Authority, set up several experiments a few years ago to prove or disprove the value of a winter legume such as hairy vetch. These experiments were so arranged that a few of the many questions pertaining to the production and value of vetch might be answered. Below are some of the questions which farmers are justified in asking and which these cooperative experiments seek to answer:

1. Will vetch yields increase or decrease if grown year after year on the same land?
2. What are the fertilizer requirements for vetch?
3. Which should receive the commercial fertilizer, vetch or the following crop of cotton?
4. How do cotton yields following vetch removed for hay compare with cotton yields following vetch turned under for green manure?
5. If vetch is removed for hay, is commercial nitrogen needed for cotton production?
6. How does vetch nitrogen compare with 200 pounds of nitrate of soda for cotton production?
7. If unfertilized vetch is removed for hay, how will 3-8-4 fertilizer applied under cotton compare with 6-8-4 fertilizer?

In the absence of research information, it was necessary to conduct experiments over a period of years to prove the answers to these and other questions. For instance, many farmers are of the opinion that vetch yields progressively decrease if planted on the same land year after year. This is no doubt the case in some instances, and there are several factors that have caused this trouble. Some of the major ones are methods of planting, dates of seeding, inoculation, fertilizers, and weather conditions. All of the above problems can be somewhat controlled, except the last.

Will vetch yields decrease if grown annually on the same land?

To determine whether vetch yields increased or decreased if planted on the same land year after year, experiments were conducted at four locations. The experiment conducted on the farm of T. F. Richards, Columbus, Mississippi, was begun in the fall of 1938 and is being continued. Five crops have been grown and turned under to date.

Table 1A shows year-by-year data for a period of 5 years during which eight different fertilizer treatments and one no-fertilizer treatment were used. These data show the first 2 years were by far the lowest in respect to yields. An average for all fertilizer treatments (with the exception of lime alone) gives yields of slightly over a ton of green vetch per acre during the first 2 years. Yields for the last 3 years (with the same exception for lime alone) are slightly above 4 tons per acre, and the average for the 5-year period is about 3½ tons of green vetch per acre.

At another location, on the farm of H. H. Porter, Columbus, Mississippi, a similar experiment was begun at the same time and is being continued. Table 1B shows yields by years for the different fertilizer treatments. The results are similar to those at the T. F. Richards' farm in that the average yields for the first 2 years are slightly over 1 ton of green vetch per acre. The 1941 yields practically double the average yields for the years 1939 and 1940. The 1942 vetch crop was a complete failure, due largely to shallow planting the latter part of September 1941. Perhaps enough moisture was in the soil to germinate the seed, but several weeks of dry weather followed planting and most of the vetch died. The 1943 yields were far superior to those of any other years. All fertilizer-treated plots (with the exception of lime alone), produced more than 5 tons of green vetch per acre. Even including the complete failure for 1942, the 5-year average yields were slightly over 2 tons of green vetch per acre.

A somewhat different type of experiment is being conducted on the farm of R. M. and W. C. Stinson, Columbus Mississippi. This experiment was begun in the fall of 1939 and will be continued for several more years. Table 1C presents year-by-year results for a 4-year period. These data show an average production of 1 ton of green vetch per acre for all fertilizer treatments during the year of 1940. Vetch was a complete failure in 1941, perhaps due to the method and date of seeding, as it was planted shallow and late in October.

The 1942 and 1943 yields were excellent for all fertilizer treatments. All of the 1943 yields were slightly superior to yields from the same treatments in 1942. The 4-year average yields for all fertilizer treatments were better than 2 tons per acre, even including in the average one complete failure during the 4-year period.

The experiment at the Holly Springs Branch Station, Holly Springs, Mississippi, was the same type of experiment as that at the R. M. and W. C. Stinson's farm; it was begun in the fall of 1939 and is also being continued. Results in table 1D present annual yields for a 4-year period. These data show slightly over 1½ tons of green vetch per acre for the first year, and approximately 3½ to 5 tons for the different fertilizer treatments the second year. The third year yields were superior to the first year, in that about a 4½-ton average for all fertilizer treatments was obtained. The greatest yields were obtained the fourth year, when 4½ to 5 tons of green vetch were produced per acre. These data

Table 1. The effect of vetch on soil fertility, 1938-43

A. Savannah fine sandy loam; farm of T. F. Richards, Star Rt., Columbus

Year Planting date Turning date	1938 Nov. 10	1939 Oct. 27 Apr. 21	1940 Oct. 29 May 2	1941 Oct. 16 Apr. 22	1942 Oct. 26 Apr. 15	1943 Oct. 6 Apr. 12	5-year average	5-year average increase over no fertilizer
Fertilizer treatment*			Yields in pounds of green vetch per acre					
Superphosphate	....	2,508	2,332	10,720	8,192	9,600	6,670	4,340
Basic slag	....	2,100	1,992	10,704	10,448	10,688	7,186	4,856
Triple super	....	1,768	1,822	9,584	7,488	10,240	6,180	3,850
Super + dolomite	....	2,680	2,434	10,560	9,728	9,432	6,966	4,636
Basic slag + dolomite	....	2,148	2,320	10,320	9,680	10,744	7,042	4,712
Triple + dolomite	....	2,220	2,240	10,672	9,024	11,152	7,061	4,731
Super + KCl	....	2,332	2,568	11,200	9,600	11,472	7,434	5,104
Dolomite	....	1,037	825	3,904	2,912	3,096	2,354	24
No fertilizer	....	934	789	4,016	2,921	2,992	2,330	....

B. Ruston fine sandy loam; farm of H. H. Porter, Columbus

Year Planting date Turning date	1938 Nov. 10	1939 Oct. 27 Apr. 20	1940 Nov. 6 May 12	1941 Sept. 26 Apr. 23	1942 Sept. 29 failure	1943 Oct. 6 Apr. 12	5-year average	5-year average increase over no fertilizer
Fertilizer treatment*			Yields in pounds of green vetch per acre					
Superphosphate	....	2,556	2,044	5,232	....	10,320	4,030	2,170
Basic slag	....	2,592	2,292	5,136	....	15,507	5,105	3,245
Triple super	....	2,136	1,886	4,947	....	11,232	4,040	2,180
Super + dolomite	....	2,828	2,578	6,672	....	12,416	4,898	3,038
Basic slag + dolomite	....	2,880	2,602	6,656	....	12,416	4,910	3,050
Triple + dolomite	....	2,264	2,416	5,520	....	12,696	4,579	2,719
Super + KCl	....	2,088	2,242	4,256	....	11,352	3,987	2,127
Dolomite	....	1,472	1,451	3,872	....	4,616	2,282	422
No fertilizer	....	1,427	1,081	2,864	....	3,928	1,860	....

C. Savannah fine sandy loam; farm of R. M. and W. C. Stinson, Star Rt., Columbus

Year Planting date Turning date	1939 Oct. 27	1940 Oct. 29 May 2	1941 Sept. 16 failure	1942 Sept. 22 Apr. 13	1943 Sept. 13 Apr. 13	4-year average
Fertilizer treatment*		Yields in pounds of green vetch per acre				
500 lbs. 0-8-4 super	....	1920	....	8348	10000	5067
500 lbs. 0-8-0 basic slag	....	2036	....	6648	7920	4151
500 lbs. 0-8-4 triple super	....	1816	....	8072	10640	5132
500 lbs. 0-8-4 super + lime	....	2228	....	8996	10080	5326

D. Grenada silt loam; Holly Springs Branch Experiment Station, Holly Springs

Year Planting date Turning date	1939 Oct. 23 .	1940 Oct. 24 Apr. 28	1941 Oct. 17 Apr. 14	1942 Sept. 24 Apr. 20	1943 Oct. 11 Apr. 15	4-year average
Fertilizer treatment*		Yields in pounds of green vetch per acre				
500 lbs. 0-8-4 super		3205	6666	3956	9120	5736
500 lbs. 0-8-0 basic slag		3984	8709	5300	10320	7078
500 lbs. 0-8-4 triple super		2517	6373	3736	9280	5476
500 lbs. 0-8-4 super + lime		5077	11461	5476	11280	8323

*Fertilizer treatment: 43 lbs. P_2O_5 per acre, 400 lbs. dolomite, 50 lbs. muriate of potash.

further show a 4-year average yield of 5,000 to 8,000 pounds of green vetch per acre for the different fertilizer treatments.

The data shown in the four experiments do not indicate regularly increased yields year-by-year for the different fertilizer treatments, largely because of weather conditions, methods and dates of seeding, and fertilizers. However, yields during the later years were much higher than in the earlier years, and the average of yields throughout the experiments is nearly twice as high as during the first year of the experiments. It is possible that the low yields the first 2 years of most of the experiments were due in part to incomplete inoculation, even though the seed were inoculated each year. Since in every case the yields were better during the last 2 or 3 years than on the first year of the experiments, it is perhaps safe to expect yearly increases, provided proper fertilizer treatment, inoculation, and methods and dates of seeding are practiced.

What are the fertilizer requirements for vetch?

Results of fertilizers applied to legumes are somewhat conflicting. A general opinion is that legumes do not need nitrogen fertilizers, while research results more or less agree on the acute need for phosphorus on most hill soils. The data are not conclusive with respect to the value of lime and potash.

The results of an experiment conducted for a 5-year period on Savannah fine sandy loam soil in Lowndes County, Mississippi, are shown in table 2A. These data show the value of applied phosphate, alone and in combination with both potash and lime, and of lime alone: the treatments may be compared with each other and with unfertilized plots. Results are shown by years for the purpose of studying yearly trends, which may or may not be due to fertilizer treatments, since weather conditions play an important role in the production of vetch. For example, the increases for superphosphate over no fertilizer do not show definite trends year after year; however, the increases are on the upgrade, amounting to approximately 3/4 ton in 1939 and approximately 3½ tons in 1943. The 5-year average increase for phosphate over no fertilizer was more than 2 tons.

The addition of muriate of potash to the superphosphate increased yields only slightly, but definite trends for increased yields were followed. In 1939 no increases were obtained, but thereafter a gradual increase was shown year-by-year. The 1943 increase in yields due to potash added to the superphosphate is slightly less than 1 ton, which is about 2½ times the 5-year average increase in yields due to potash added to the phosphate fertilizer.

The increased yields resulting from the application of dolomite in combination with superphosphate are extremely low and show no yearly trends. In only 1 year out of 5 was an increase of as much as 3/4 ton shown as due to lime. The 5-year average increase is also low. Results from the use of lime alone are similar to those for lime used in combination with superphosphate; practically no increased yields were obtained from either use of lime.

Another experiment of the same type as the above is being conducted on the farm of H. H. Porter, Columbus, Mississippi, using Ruston fine sandy loam soil. Data in table 2B show rather low yields for applied phosphate for all years tried, with the exception of 1941 and 1943 when approximately 2½ and 5 tons were produced, respectively. The 1942 crop was a complete failure. The 5-year average increase due to applied phosphate is slightly more than 1 ton per acre.

Potash in combination with phosphorus apparently was of little value, since in only 1 year out of 5 was an increase of over 1,000 pounds of green vetch produced by the potash treatment. The

5-year average yield showed no increase attributable to the use of potash.

The combination of phosphorus and lime treatments shows increased yields year after year, with the exception of 1942, when there was a vetch failure. The yearly increases as well as the 5-year average increases for lime are somewhat low; but, excepting the vetch failure of 1942, the trend was for larger increases, due to the lime-phosphate treatment. The 5-year average increase attributable to

Table 2. The effect of fertilizers on the production of hairy vetch, 1939-43.

A. Savannah fine sandy loam; farm of T. F. Richards, Star Rt., Columbus

Fertilizer treatment* Year	1939	1940	1941	1942	1943	5-year average
	Yields and increase yields in pounds of green vetch per acre					
Superphosphate	2,508	2,332	10,720	8,192	9,600	6,670
No fertilizer	934	789	4,016	2,921	2,992	2,330
Increase over no fertilizer	1,574	1,543	8,704	5,271	6,608	4,340
Super + potash	2,332	2,568	11,200	9,600	11,472	7,434
Super	2,508	2,332	10,720	8,192	9,600	6,670
Increase over super	—176	236	480	1,408	1,872	764
Super + dolomite	2,680	2,434	10,560	9,728	9,432	6,966
Super	2,508	2,332	10,720	8,192	9,600	6,670
Increase over super	172	102	—160	1,536	—168	296
Lime alone	1,037	825	3,904	2,912	3,096	2,354
No fertilizer	934	789	4,016	2,921	2,992	2,330
Increase over no fertilizer	103	36	—112	—9	104	24

B. Ruston fine sandy loam; farm of H. H. Porter, Columbus

Fertilizer treatment* Year	1939	1940	1941	1942	1943	5-year average
	Yields and increase yields in pounds of green vetch per acre					
Superphosphate	2,556	2,044	5,232	......	10,320	4,030
No fertilizer	1,427	1,081	2,864	......	3,928	1,860
Increase over no fertilizer	1,129	963	2,368	......	6,392	2,170
Super + potash	2,088	2,242	4,256	......	11,352	3,987
Super	2,556	2,044	5,232	......	10,320	4,030
Increase over super	—468	198	—976	......	1,032	—43
Super + dolomite	2,828	2,578	6,672	......	12,416	4,898
Super	2,556	2,044	5,232	......	10,320	4,030
Increase over super	302	534	1,436	......	2,096	873
Dolomite alone	1,472	1,451	3,872	......	4,616	2,282
No fertilizer	1,427	1,081	2,864	......	3,928	1,860
Increase over no fertilizer	45	370	1,008	......	688	422

C. Savannah fine sandy loam; farm of R. M. and W. C. Stinson, Star Rt., Columbus

Fertilizer treatment* Year	1940	1941	1942	1943	4-year average
	Yields and increase yields in pounds of green vetch per acre				
0-8-4 super + lime	2,228	......	8,996	10,080	5,326
0-8-4 super	1,920	......	8,348	10,000	5,067
Increase over super	308	......	648	80	259

D. Grenada silt loam; Holly Springs Branch Experiment Station, Holly Springs

Fertilizer treatment* Year	1940	1941	1942	1943	4-year average
	Yields and increase yields in pounds of green vetch per acre				
0-8-4 super + lime	5,077	11,461	5,476	11,280	8,323
0-8-4 super	3,205	6,666	3,956	9,120	5,736
Increase over super	1,872	4,795	1,520	2,160	2,587

*Fertilizer treatment: Approximately 200 lbs. 20 percent phosphate, 50 lbs. muriate of potash, 400 lbs. dolomite.

the use of lime was less than 1,000 pounds of green vetch per acre, but the increase over phosphate alone was 1,438 pounds in 1941 and 2,096 pounds in 1943.

Lime alone in this experiment was of little value to the vetch, since the average increase in yield due to lime was only slightly over 400 pounds of green vetch per acre.

Table 2C shows the results of another experiment on Savannah fine sandy loam soil located in Lowndes County, Mississippi, and is a comparison of 0-8-4 and 0-8-4 plus lime under vetch. These data indicate that lime was of minor importance at this location. The 4-year average yield for 0-8-4 plus lime was 5,326 pounds of green vetch, and for 0-8-4 without lime it was 5,067 pounds, a difference of only 259 pounds of green vetch per acre in favor of the lime treatment.

A similar experiment was begun in 1940 at another location on a soil of Brown loam origin classed as Grenada silt loam. The results (table 2D) show annual green vetch yields on 0-8-4 plus lime plots of over 2¼ tons for each of the 2 low years and approximately 5½ tons for each of the 2 high years. The average yield for the 4-year period is slightly above 4 tons per acre for the 0-8-4 plus lime treatment. The 0-8-4 (no lime) treatment produced approximately an average of 1¾ tons for the 2 low years and slightly less than 4 tons for the 2 better years, and the 4-year average yield was slightly less than 3 tons per acre.

The limited data obtained from all experiments indicate that phosphorus is far more important for the production of hairy vetch than either potash or lime. It is perhaps possible, however, that after a long period of continued vetch cropping, both lime and potash will be needed for good vetch production. Soils having a clay or silt texture usually make use of more lime for the same crops than do soils with a sandy texture.

Two methods are usually used in applying lime: broadcast and drilled. As with other fertilizers, most soils require less of the material drilled than broadcast, as the drilled material is more concentrated. Then the problem of how often to apply lime is in the picture. Should it be applied annually in small amounts or in larger amounts every 2, 3, or 4 years? Apparently, much more research work with lime on the hill soils of Mississippi will be welcomed.

It should be emphasized that these data refer only to the fertilizer requirements of vetch, as measured by vetch yields. When cotton follows immediately after the vetch is removed or turned under, the fertilizer requirements for cotton must also be considered. On most hill soils potash is required for optimum cotton production. This section should therefore be studied in conjunction with other sections of this report, particularly the section which follows.

Which should receive the commercial fertilizer, vetch or the following crop of cotton?

If phosphorus is the major fertilizer for vetch, and potash and lime play less important roles, what are the fertilizer requirements for the following crop of cotton? Should the fertilizer be applied to the vetch or to the cotton?

To find an answer to the above question, the results of two experiments for a 4-year period at two locations are appropriate for use (table 3). Since the results were taken from two different soil types, the results are presented separately. At the Holly Springs Branch Station (table 3A) on Grenada silt loam soil, cotton following vetch fertilized with 500 pounds of 0-8-4 per acre (no fertilizer under cotton) yielded 728 pounds of seed cotton per acre in 1940; whereas 896 pounds of seed cotton was produced when 500 pounds of 0-8-4 was applied

Table 3. Comparison of the effect on cotton yield of fertilized vetch followed by cotton with unfertilized vetch and fertilized cotton, 1940-43

A. Grenada silt loam; Holly Springs Branch Experiment Station, Holly Springs

Year	Fertilized* vetch	Cotton after fertilized vetch	Unfertilized vetch	Fertilized* cotton	Differences
Yields and increased yields in pounds of green vetch and seed cotton per acre					
1940	3,205	728	1,328	896	168 lbs. increase for fertilized cotton
1941	6,666	940	4,953	1,046	106 lbs. increase for fertilized cotton
1942	3,956	1,436	3,065	1,356	80 lbs. increase for fertilized vetch
1943	9,120	740	7,520	768	28 lbs. increase for fertilized cotton
4-year av.	5,736	961	4,216	1,016	55 lbs. av. inc. for fertilized cotton

B. Savannah fine sandy loam soil; farm of R. M. and W. C. Stinson, Columbus

Year	Fertilized* vetch	Cotton after fertilized vetch	Unfertilized vetch	Fertilized* cotton	Differences
Yields and increased yields in pounds of green vetch and seed cotton per acre					
1940	1,920	272	1,064	332	60 lbs. increase for fertilized cotton
1941	--------	--------	--------	--------	--------
1942	8,348	1,280	4,880	1,328	48 lbs. increase for fertilized cotton
1943	10,000	936	7,840	1,080	144 lbs. increase for fertilized cotton
4-year av.	5,067	622	3,446	685	63 lbs. av. inc. for fertilized cotton

*Fertilizer treatment: 500 pounds 0-8-4 per acre for fertilized vetch, 500 pounds 0-8-4 per acre for fertilized cotton.

under cotton (no fertilizer under vetch) the same year.

This was a difference in 1940 of 168 pounds of seed cotton in favor of fertilizer applied to cotton. The increase for 1941 was 106 pounds of seed cotton in favor of the fertilizer applied to cotton. In 1942 the situation was reversed, and 80 pounds more of seed cotton was obtained where the fertilizer was applied to vetch. In 1943 there was an increase of 28 pounds of seed cotton in favor of the fertilizer applied to cotton. The 4-year average increase was 55 pounds in favor of fertilizer applied to cotton.

There seems to be a trend of gradual increase in cotton following fertilized vetch, and it is possible that in a long time rotation of the two crops a decided advantage may be shown for fertilizing the vetch rather than the cotton.

On Savannah fine sandy loam soil (table 3B) in Lowndes County, Mississippi, a somewhat different answer to the question was given. The 1940 yields of both vetch and cotton were very low. However, by fertilizing the cotton following unfertilized vetch, 60 pounds more seed cotton was obtained than for the fertilized vetch followed by unfertilized cotton. The year of 1941 was a complete failure for both vetch and cotton. The cotton failure was due to lack of sufficient moisture to establish stands until after the 4th of July; the late cotton made good growth, but because of boll weevils there was not a mature boll in the field.

The 1942 yields were excellent for both methods of applying fertilizer. Plots on which the fertilizer was applied under cotton produced 48 pounds more seed cotton than those on which fertilizer was applied to vetch. Also, in 1943 the fertilized cotton was the best, leading with 144 pounds seed cotton increase. The 4-year average, however, was only 63 pounds increase in favor of fertilized cotton following unfertilized vetch over unfertilized cotton following fertilized vetch.

The results of the two experiments are somewhat inconsistent in that the response of cotton to applied fertilizer at the two locations do not agree in every respect; however, the 4-year average increases for the two locations are about the same, 63 pounds and 55 pounds, respectively, in favor of fertilized cotton following unfertilized vetch. Perhaps it makes little difference whether the fertilizer is applied to cotton or to vetch since it is apparent that both vetch and cotton will feed on the residual fertilizer of the preceding season.

How do cotton yields following vetch cut for hay, compare with cotton yields following vetch turned under?

When a full crop of vetch is grown and turned back to the soil, benefits are derived from the leaves and stems above the ground and from the roots in the soil, as well as from the nitrogen the legume has stored in the soil during its growing season. If the leaves and stems are removed for hay, the benefits are from the stubble and roots and stored nitrogen only.

Table 4 shows results of two experiments for 4-year periods which make comparisons of vetch removed for hay and vetch turned under, as measured by the following crops of cotton. The data for crops grown on Grenada silt loam soil (table 4A) show little or no difference in cotton yields following turned vetch or vetch cut for hay the first year, 1940, when the difference of 40 pounds of seed cotton was secured when vetch was removed for hay. For 1941, 248 pounds more seed cotton per acre was secured from turned vetch than from vetch removed for hay. The increase for cotton following turned vetch was 376 pounds more seed cotton in 1942, and 68 pounds more in 1943. The 4-year average increase for cotton following turned vetch was 163 pounds more seed cotton than for cotton following vetch removed for hay.

The data for crops grown on Savannah fine sandy loam soil (table 4B) show somewhat similar results to those obtained on Grenada soils, in that little or no advantage was shown the first

Table 4. The effect of the removal of vetch hay on the following crop of cotton

A. Grenada silt loam soil, Holly Springs Branch Experiment Station, Holly Springs

Year	Turned vetch	Vetch removed for hay	Cotton yield following turned vetch	Cotton yield following vetch removed for hay	Increase
	Yield and increase yields in pounds of green vetch and seed cotton per acre				
1940	3,221	3,205	728	768	—40
1941	7,280	6,666	1,210	962	248
1942	3,380	3,956	1,436	1,060	376
1943	8,880	9,120	740	672	68
4-year average	5,690	5,736	1,028	865	163

B. Savannah fine sandy loam soil, farm of R. M. and W. C. Stinson, Columbus

Year	Turned vetch	Vetch removed for hay	Cotton yield following turned vetch	Cotton yield following vetch removed for hay	Increase
	Yield and increase yields in pounds of green vetch and seed cotton per acre				
1940	1,920	1,920	272	276	—4
1941	failure	failure	failure	failure	. . .
1942	8,348	7,944	1,280	1,128	152
1943	10,000	9,600	936	864	72
4-year average	5,067	4,866	622	567	55

Fertilizer treatment: 500 pounds 0-8-4 fertilizer applied to vetch, no fertilizer under cotton.

Table 5. The effect of commercial nitrogen applied to cotton following vetch removed for hay, 1940-43

A. Soil type, Grenada silt loam

Year	0-8-4* under vetch	No fertilized cotton	0-8-4 under vetch	3-0-0* under cotton	Differences
	Yields and increased yields in pounds of green vetch and seed cotton per acre				
1940	3,221	728	3,504	920	192 lbs. increase for 3-0-0
1941	7,280	940	6,869	982	42 lbs. increase for 3-0-0
1942	3,380	1,436	4,496	1,284	—152 lbs. decrease for 3-0-0
1943	8,880	740	9,440	684	—56 lbs. decrease for 3-0-0
4-year av.	5,690	961	6,077	967	6 lbs. average increase for 3-0-0

B. Soil type, Savannah fine sandy loam

Year	0-8-4* under vetch	No fertilized cotton	0-8-4 under vetch	3-0-0* under cotton	Differences
	Yields and increased yields in pounds of green vetch and seed cotton per acre				
1940	1,920	276	1,992	328	52 lbs. increase for 3-0-0
1941	----	-------	-------	-------	-------
1942	7,944	1,128	6,588	1,120	—8 lbs. decrease for 3-0-0
1943	9,600	864	9,120	856	—8 lbs. decrease for 3-0-0
4-year av.	4,866	567	4,425	576	9 lbs. average increase for 3-0-0

*Fertilizer treatment: 500 pounds 0-8-4 under vetch, 500 pounds 3-0-0 under cotton.

year for turned vetch over vetch cut for hay. Both vetch and cotton were complete failures during the second year, 1941. Third year results show an increase of 152 pounds of seed cotton in favor of turned vetch over cotton yields following vetch cut for hay. The fourth year results were also similar to those on Grenada soils in that only 72 pounds more seed cotton was obtained from turned vetch than from vetch cut for hay. The 4-year average results show only 55 pounds more seed cotton following turned vetch than when vetch was removed for hay. It is entirely possible that at both locations the low increases for turned vetch in 1943 were due to dry weather, since it was possible to find undecomposed vetch at harvest time. There was not enough moisture during the growing season to cause decomposition.

Chemical analyses show that considerable quantities of plant food are removed in any hay plant, thus tending toward decreasing cotton yields following such removal of vetch for hay. The decreased yields of cotton were perhaps not enough during the 4-year period to offset the value of vetch hay harvested, but continued over a long period of time the soil might be badly depleted of its plant food nutrients by the annual removal of hay crops.

If vetch is removed for hay, what is the value of commercial nitrogen applied to the following crop of cotton?

When vetch is removed from the soil as hay, the only benefits remaining to the soil are secured from the stubble and roots and from nitrogen stored during the life of the vetch. The question then arises, what is the value of commercial nitrogen applied to the following crop of cotton? Table 5 shows results of two experiments over a 4-year period.

The data obtained on Grenada silt loam soil (table 5A), where fertilized vetch had been cut for hay, show an increase of 192 pounds of seed cotton per acre for approximately 100 pounds of commercial nitrogen (nitrate of soda) for the first year of the experiment. The same amount of nitrogen the second year increased cotton yields only 42 pounds. During the third and fourth years of the experiment, the unfertilized cotton produced about as much increase as did the cotton receiving 100 pounds of commercial nitrogen the first two years. The 4-year average increase for 100 pounds of commercial nitrogen fertilizer was only 60 pounds of seed cotton. At this location, commercial nitrogen applied at the rate of 100 pounds per acre to cotton following vetch fertilized with 0-8-4 and cut for hay, had but little value over a period of 4 years.

Results of the experiment conducted on Savannah fine sandy loam soil are similar to those on Grenada silt loam. These data (table 5B) show 52 pounds of seed cotton per acre increase the first year for the 100 pounds of nitrogen fertilizer applied to cotton following vetch cut for hay, over unfertilized cotton following vetch cut for hay. Both vetch and cotton failed the second year. The third and fourth year results show no increases for applied nitrogen; and the 4-year average increase was only 9 pounds of seed cotton per acre. At this location, as at the one on Grenada soil, commercial nitrogen alone appears to be of little value to cotton following vetch removed for hay.

How does nitrogen supplied by a crop of unfertilized vetch plowed under, compare with 200 pounds of nitrate of soda per acre?

Complete fertilizer for cotton has been considered a good practice on most of our hill soils for some time. Some farmers practice growing vetch without fertilizer and following it with cotton treated with a complete fertilizer. The question then arises, will unfertilized vetch removed as hay produce nitrogen equal to one-half the amount supplied in commercial 6-8-4 as measured by increased yields of cotton? Stating the question another way, will vetch cut for hay supply half the nitrogen needed by the following crop of cotton?

Table 6 shows results of two experiments for a period of 4 years each, giving annual yields of cotton in a com-

Table 6. A comparison of the effect of 3-8-4 fertilizer under cotton following unfertilized vetch removed for hay, with 6-8-4 under cotton not following vetch, 1940-43

A. Soil type, Grenada silt loam

Year	Unfertilized vetch	3-8-4* under cotton	6-8-4* under cotton	Increase over 3-8-4 under cotton following unfertilized vetch removed for hay
Yields and increased yields in pounds of green vetch and seed cotton per acre				
1940	1,045	1,080	1,280	200
1941	4,192	982	1,254	272
1942	2,828	1,456	1,696	240
1943	6,960	660	784	124
4-year average	3,756	1,044	1,253	209

B. Soil type, Savannah fine sandy loam

Year	Unfertilized vetch	3-8-4* under cotton	6-8-4* under cotton	Increase over 3-8-4 under cotton following unfertilized vetch removed for hay
Yields and increased yields in pounds of green vetch and seed cotton per acre				
1940	980	452	524	72
1941	....	....	....	...
1942	4,820	1,272	1,300	28
1943	6,800	1,032	1,084	52
4-year average	3,150	689	727	38

*Fertilizer treatment: 500 pounds 3-8-4 per acre, 500 pounds 6-8-4 per acre.

parison of (1) 500 pounds 3-8-4 applied under cotton following a crop of unfertilized vetch cut for hay and the roots plowed under, and (2) 500 pounds 6-8-4 fertilizer applied under cotton not following vetch. The nitrogen in 500 pounds 3-8-4 fertilizer is equal to nearly 100 pounds of a 16 percent nitrogen fertilizer, such as nitrate of soda; and the nitrogen in 500 pounds of 6-8-4 fertilizer to nearly 200 pounds nitrate of soda.

These data show from 200 pounds to 272 pounds increase in seed cotton per acre for 3 of the 4 years, 124 pounds increase for the fourth year, and a 4-year average increase of 209 pounds of seed cotton, in favor of the 6-8-4 fertilizer treatment without vetch, over the 3-8-4 fertilizer under cotton following unfertilized vetch removed for hay. It is evident that cotton grown on Grenada silt loam soil (table 6A) shows a much greater response to 200 pounds of commercial nitrogen in a complete fertilizer than it does to 100 pounds of commercial nitrogen in a complete fertilizer plus vetch nitrogen obtained from unfertilized vetch removed as hay.

Results of the experiment conducted on Savannah fine sandy loam soil are given in table 6B. These data show 72 pounds of seed cotton increase for 500 pounds 6-8-4 applied under cotton not following vetch, over 500 pounds 3-8-4 fertilizer applied under cotton following unfertilized vetch cut for hay. The 1941 vetch and cotton crops were complete failures. Increases for the full nitrogen ratio in fertilizer applied under the cotton not following vetch, over the half-vetch-nitrogen, half-commercial nitrogen treatment, were 28 pounds and 52 pounds of seed cotton, respectively, in 1942 and 1943. The 4-year average increase was 38 pounds in favor of the 6-8-4 over 3-8-4 plus nitrogen obtained from unfertilized vetch removed as hay.

Even though the increased yields are low and possibly not significant, there is some indication that not enough nitrogen is obtained from unfertilized vetch removed for hay to supply one-half the amount of nitrogen applied in a 6-8-4 complete fertilizer on Savannah fine sandy loam soil. It is definitely not enough on Grenada silt loam soil, when cotton is used as the indicator crop.

It is difficult to obtain data enough and over a long enough period of time to evaluate the efficiency of vetch nitrogen as measured by pounds of seed cotton produced after vetch. It is necessary to have some kind of a yardstick to measure with. For instance, most of the hill soils of Mississippi do not produce good crops of vetch without fertilizer, especially phosphate. Therefore, if the fertilizer is applied to the vetch in the fall, this fertilizer treatment is not directly comparable with spring application of phosphate under cotton.

Then, too, if fertilizers other than nitrogen are applied to the cotton following unfertilized vetch, the vetch yields may not be enough to furnish the amount of nitrogen to be compared with commercial nitrogen applied in complete fertilizer. The question of lime for both vetch and cotton also enters the picture and may play an important role when legumes are grown on the same soils for a long period of time.

If the vetch crop is turned under, will the vetch nitrogen made available to the following crop of cotton, be as good as or better than commercial nitrogen in 500 pounds of 6-8-4 fertilizer applied to cotton not following vetch?

Table 7 shows results of two experiments comparing vetch nitrogen with commercial nitrogen as measured by the following crop of cotton. Comparisons are made of cotton yields following vetch fertilized with 0-8-4, of cotton yields following unfertilized vetch, and of yields of cotton fertilized with 6-8-4 and not following vetch. Results of vetch ferti-

Table 7. A comparison of vetch nitrogen with commercial nitrogen for the production of seed cotton, 1940-43.

A. Soil type, Grenada silt loam

Year	0-8-4 fertilizer under vetch				No fertilizer under vetch			0-8-4 plus lime under vetch			No fertilizer
	1	2	3	4	5	6	7	8	9	10	11
	Yields in pounds of green vetch and seed cotton per acre										
1940	3,205	728	1,280	552	1,328	896	348	5,077	1,056	224	872
1941	6,666	940	1,254	314	4,953	1,046	208	11,461	1,106	148	812
1942	3,956	1,436	1,696	260	3,064	1,356	340	5,476	1,548	148	792
1943	9,120	740	784	44	7,520	768	16	11,280	696	88	560
4-year average	5,736	961	1,254	293	4,216	1,017	237	8,323	1,102	152	759

B. Soil type, Savannah fine sandy loam

Year	1	2	3	4	5	6	7	8	9	10	11
	Yields in pounds of green vetch and seed cotton per acre										
1940	1,920	272	524	252	1,064	332	192	2,228	316	208	276
1941	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------	-------
1942	8,348	1,280	1,300	20	4,880	1,328	–28	8,996	1,424	—124	584
1943	10,000	936	1,084	148	7,840	1,080	4	10,080	1,192	—108	536
4-year average	5,067	622	727	105	3,446	685	42	5,326	733	—6	349

Fertilizer treatment, 500 pounds per acre; lime treatment, 500 pounds dolomitic limestone per acre.

Column 1. Vetch yields, 0-8-4 fertilizer under vetch.
Column 2. Cotton yields following vetch fertilized with 0-8-4.
Column 3. Cotton yields, 6-8-4 fertilizer (no vetch).
Column 4. Increased cotton yields for 6-8-4 under cotton over vetch nitrogen and residual 0-8-4.
Column 5. Unfertilized vetch yields.
Column 6. Cotton yields following unfertilized vetch plus 0-8-4 under cotton.
Column 7. Increased cotton yields for 6-8-4 under cotton over no fertilized vetch and 0-8-4 under cotton.
Column 8. Vetch yields, 0-8-4 plus lime under vetch.
Column 9. Cotton yields following vetch fertilized with 0-8-4 plus lime.
Column 10. Increased cotton yields for 6-8-4 under cotton over cotton yields following vetch fertilized with 0-8-4 plus lime.
Column 11. No-fertilizer cotton yields.

lized with 0-8-4, with 0-8-4 plus lime, and of no fertilizer for cotton, are also shown.

Grenada Silt Loam Soil

Column 1, table 7A, shows annual and 4-year average yields of vetch on Grenada silt loam soil. These data show fairly good yields for the 4-year period, with a 4-year average yield of 5,736 pounds of green vetch per acre. Column 2 of the same table shows yields of seed cotton following fertilized vetch. These data show yields of 728 pounds of seed cotton per acre for the low year and 1,436 pounds the high year, with a 4-year average of 961 pounds. Column 3 shows cotton yields fertilized with 500 pounds of 6-8-4 per acre (no vetch). These data show 784 pounds of seed cotton for the low year, 1,696 pounds for the high year, and 1,254 pounds for the 4-year average.

Column 4 shows an annual increase in cotton yields and 4-year average increased yields in favor of cotton fertilized with 6-8-4, over cotton following vetch fertilized with 0-8-4. These data show increased yields of 44 pounds of seed cotton per acre for the low year, and 552 pounds for the high year, with a 4-year average increase of 293 pounds. It is interesting to note that at this location the annual increased yields decrease annually from 552 pounds the first year to only 44 pounds the fourth year. This may indicate that over a period of time. fertilized turned vetch might increase cotton production as well as or better than commercial nitrogen.

Column 5 shows annual yields and 4-year average yields for the unfertilized vetch, the 4-year average yield being slightly more than 2 tons per acre. Column 6 shows cotton yields following unfertilized vetch, 0-8-4 fertilizer was applied under cotton. This is perhaps the only direct comparison of vetch nitrogen with commercial nitrogen, since in both cases the fertilizer was applied directly to the cotton. The vetch was no doubt able to feed on the residual phosphate and potash applied to the cotton, but the cotton grown on the no-vetch plots also had residual phosphate and potash on which to feed. It will be necessary to study columns 3, 5, 6, 7, and 11 in table 7A for this comparison.

During the first year of the experiment the unfertilized vetch (column 5) produced only 1,328 pounds of green vetch per acre. Cotton following this vetch and fertilized with 500 pounds of 0-8-4 per acre (column 6) produced 896 pounds of seed cotton. The 500 pounds of 6-8-4 (column 3) produced 1,280 pounds of seed cotton, a difference of 348 pounds of seed cotton (column 7) in favor of commercial nitrogen over vetch nitrogen. The no-vetch, no-fertilizer plot (column 11) produced 872 pounds of seed cotton, which was almost as good as the vetch nitrogen plot but inferior to the commercial nitrogen.

The second year of the experiment shows 4,953 pounds of vetch (column 5) for the unfertilized vetch plot. Cotton following the unfertilized vetch but receiving 500 pounds of 0-8-4 produced 1,046 pounds of seed cotton (column 6). The 6-8-4 treatment (column 3) produced 1,254 pounds of seed cotton, a difference of 208 pounds (column 7) in favor of commercial nitrogen. The no-vetch, no-fertilizer plot (column 11) produced 812 pounds of seed cotton, or 234 pounds less than the vetch nitrogen and 442 pounds less than the commercial nitrogen plots.

The third year results show 3,064 pounds of green vetch (column 5) for the unfertilized vetch and 1,356 pounds of seed cotton from the plots (column 6) following the unfertilized vetch but receiving 500 pounds of 0-8-4. The 6-8-4 treatment (no vetch) produced 1,696 pounds of seed cotton (column 3), a difference of 340 pounds of seed cotton (column 7) in favor of commercial nitrogen. The unfertilized cotton (column 11) produced 792 pounds, which was 564 pounds less than the 0-8-4 treatment following vetch and 904 pounds less than the 6-8-4 treatment not following vetch.

The fourth year results show 7,520 pounds of green vetch per acre (column 5) for the unfertilized vetch, which is the largest yield of unfertilized vetch during the trial. Cotton following this vetch and receiving 500 pounds of 0-8-4 produced 768 pounds of seed cotton (column 6), whereas cotton without a preceding crop of vetch but fertilized with 500 pounds of 6-8-4 produced 784 pounds (column 3), a difference of 16 pounds of seed cotton in favor of commercial nitrogen over vetch nitrogen. The unfertilized cotton produced 560 pounds of seed cotton, which was 208 pounds less than the 0-8-4 vetch production treatment when the nitrogen was applied, and 224 pounds less than the yield on the 6-8-4 no-vetch plots. The cotton yields were reduced considerably during the fourth year by the preceding vetch and 500 pounds of 0-8-4 was applied per acre, because of extreme drought.

The 4-year average yield for the unfertilized vetch was 4,216 pounds of green vetch per acre. Cotton following unfertilized vetch and fertilized at the rate of 500 pounds of 0-8-4 per acre, produced an average yield of 1,017 pounds of seed cotton. The 500 pounds of 6-8-4 with no vetch produced an average yield of 1,254 pounds, a difference of

237 pounds in favor of commercial nitrogen over vetch nitrogen. The 4-year average yield for the no-vetch, no-fertilizer plots was 759 pounds of seed cotton, which is 258 pounds less than the 0-8-4 treatment following vetch and 495 pounds less than the 6-8-4 treatment not following vetch.

Column 8 shows yields of vetch fertilized with 500 pounds of 0-8-4 plus 500 pounds of dolomitic limestone per acre. These data show yields from 2½ to 5½ tons of green vetch per acre and a 4-year average yield of more than 4 tons. Cotton following this vetch treatment (column 9) produced 1,056 pounds of seed cotton the first year, 1,106 pounds the second year, 1,548 pounds the third year, and 696 pounds the fourth year. The 4-year average yield was 1,102 pounds. Column 10 shows increased yields in pounds of seed cotton in favor of 500 pounds of 6-8-4 without vetch, over 500 pounds of 0-8-4 and 500 pounds of dolomitic limestone under vetch followed by unfertilized cotton. Annual increases were 224 pounds, 148 pounds, 148 pounds, and 44 pounds of seed cotton, respectively. The 4-year average increase was 152 pounds. The increased yields showed a tendency toward a downward trend; that is, the vetch-fertilizer-lime treatment improved in relative position during the later years of the test. Where commercial nitrogen was used as the source of nitrogen, with one exception the increased yields were less than the year before, and the third year increase was the same as the second year increase.

A summary of the results in table 7A shows 4-year average yields as follows:

Cotton fertilized with 500 pounds 6-8-4 (no vetch) produced 1,254 pounds of seed cotton;

Cotton following vetch fertilized with 500 pounds of 0-8-4 plus 500 pounds lime, produced 1,102 pounds of seed cotton;

Cotton following unfertilized vetch but fertilized with 500 pounds of 0-8-4, produced 1,017 pounds of seed cotton;

Cotton following vetch fertilized with 500 pounds of 0-8-4, nothing under cotton, produced 961 pounds of seed cotton;

Cotton neither fertilized nor following vetch produced 759 pounds of seed cotton per acre.

Savannah Fine Sandy Loam Soil

A similiar comparison of vetch nitrogen with commercial nitrogen on Savannah fine sandy loam soil is shown in table 7B. Column 1 shows annual and 4-year average yields of vetch fertilized with 500 pounds 0-8-4 These data show very low yields for the first 2 years of the experiment; however, the yields for 1942 and 1943 were 8,348 pounds and 10,000 pounds, respectively, which are very good yields. The 4-year average was 5,067 pounds.

Column 2 of the same table shows cotton yields following the vetch fertilized with 500 pounds of 0-8-4 per acre. These data, like the vetch yields in column 1, show low yields during the first 2 years of the experiments; however, the yields for 1942 and 1943 were 1,280 pounds and 936 pounds of seed cotton per acre, respectively. The 4-year average yield was 622 pounds of seed cotton per acre.

Column 3 shows yields of cotton fertilized with 500 pounds of 6-8-4 per acre (no vetch). Yields were 524 pounds of seed cotton per acre during the first year and zero for the second year because of cotton failure. Yields for 1942 and 1943 were 1,300 pounds and 1,084 pounds, respectively. The 4-year average was 727 pounds.

Column 4 shows annual and 4-year average increased yields for 500 pounds of 6-8-4 under cotton without vetch, over 500 pounds of 0-8-4 applied to vetch and the cotton unfertilized. These data show increased yields of 252 pounds, 20 pounds, and 148 pounds, respectively, for the years 1940, 1942, and 1943 in favor of 6-8-4 under cotton. The 4-year average increased yield was 105 pounds of seed cotton per acre in favor of 6-8-4 under cotton. At this location the greatest increase in yields was obtained the first year; and even though the fourth year showed a greater increase than did the third, there was some indication that the nitrogen in the 6-8-4 fertilizer under cotton did not sustain cotton yields from year to year as well as did vetch nitrogen.

Column 5 shows annual and 4-year average yields for the unfertilized vetch in pounds per acre of green weight. Figures in this column are comparable with those for fertilized vetch in column 1, and the differences—an average of about ¾ ton of green vetch—are due to 0-8-4 fertilizer treatment.

Column 6 shows cotton yields following unfertilized vetch, with 0-8-4 fertilizer applied under cotton. This column permits a direct comparison of vetch nitrogen with commercial nitrogen by study in conjunction with columns 3, 5, 6, 7, and 11 in table 7B. During the first year of the experiment the unfertilized vetch (column 5) produced only 1,064 pounds of green vetch per acre. Cotton following this vetch and fertilized with 500 pounds of 0-8-4 per acre (column 6) produced 332 pounds of seed cotton. The 500 pounds of 6-8-4 (column 3) produced 524 pounds of seed cotton; a difference of 192 pounds of seed cotton (column 7) in favor of commercial nitrogen over vetch nitrogen.

The no-vetch, no-fertilizer plot (column 11) produced 276 pounds of seed cotton in 1940, a difference of 56 pounds of seed cotton in favor of cotton fertilized with 0-8-4 following unfertilized vetch, and 248 pounds in favor of cotton fertilized with 6-8-4 (no vetch). The second year, 1941, was a failure for both vetch and cotton. The third year results show 4,840 pounds of green vetch (column 5) for the unfertilized vetch and 1,328 pounds of seed cotton (column 6) receiving 500 pounds of 0-8-4 and following the unfertilized vetch. The 6-8-4 treatment (no vetch) produced 1,300 pounds of seed cotton (column 3), a difference of 28 pounds of seed cotton (column 7) in favor of vetch nitrogen.

In 1942 the unfertilized cotton (column 11) produced 584 pounds, which was 744 pounds less than the 0-8-4 treatment following vetch and 716 pounds less than the 6-8-4 no-vetch treatment. The fourth year results show 7,840 pounds of green vetch per acre (column 5) for the unfertilized vetch. Cotton following this vetch and fertilized with 500 pounds of 0-8-4 produced 1,080 pounds of seed cotton (column 6); whereas cotton not following vetch but fertilized with 500 pounds of 6-8-4 produced 1,084 pounds of seed cotton (column 3), a difference of 4 pounds of seed cotton in favor of commercial nitrogen over vetch nitrogen.

In 1943 the unfertilized cotton produced 536 pounds of seed cotton, which was 544 pounds less than the 0-8-4 treatment and 548 pounds less than the 6-8-4 treatment. The 4-year average yields for the unfertilized vetch was 3,446 pounds of green vetch per acre. Cotton following unfertilized vetch and fertilized with 500 pounds of 0-8-4 per acre produced an average yield of 685 pounds of seed cotton. The 500 pounds of 6-8-4 (no vetch) produced an average yield of 727 pounds; the difference was 42 pounds in favor of commercial nitrogen over vetch nitrogen. The 4-year average yield for the no-vetch, no-fertilizer treatment was 349 pounds of seed cotton, which is 336 pounds less than the 0-8-4 treatment and 378 pounds less than the 6-8-4 treatment.

Column 8 table 7B shows yields of vetch fertilized with 500 pounds of 0-8-4 plus 500 pounds of dolomitic limestone per acre. These data are referred to elsewhere in this report, but to compare the cotton yields following this fertilizer treatment with 500 pounds of 6-8-4, they are referred to again. Cotton following this vetch (column 9) produced 316 pounds of seed cotton the first year; whereas, cotton fertilized with 500 pounds of 6-8-4 (no vetch) produced 524 pounds, a difference of 208 pounds in favor of 6-8-4 over 0-8-4 plus lime.

The third year, 1942, cotton following the limed-fertilized vetch produced 1,424 pounds of seed cotton, a difference of 125 pounds of seed cotton in favor of 0-8-4 plus lime over 6-8-4.

During the fourth year, 1943, the limed-fertilized vetch was followed by a yield of 1,192 pounds of seed cotton, and the 6-8-4 (no vetch) treatment produced 1,084 pounds, a difference of 108 pounds of seed cotton in favor of 0-8-4 plus lime under vetch. The 4-year average yield for 0-8-4 plus lime was 733 pounds, and the average yield for 6-8-4 treatment was 727 pounds; a difference of only 6 pounds of seed cotton in favor of 500 pounds of 0-8-4 and 500 pounds of lime under vetch over 500 pounds of 6-8-4 under cotton.

A summary of the results in table 7B shows the 4-year average yields as follows:

Cotton fertilized with 500 pounds of 6-8-4 (no vetch) produced 727 pounds of seed cotton;

Cotton following vetch fertilized with 500 pounds of 0-8-4 plus 500 pounds of dolomitic limestone (applied in drill) produced 733 pounds of seed cotton;

Cotton following unfertilized vetch but fertilized with 500 pounds of 0-8-4 produced 685 pounds of seed cotton;

Cotton following vetch fertilized with 500 pounds of 0-8-4, nothing under cotton, produced 622 pounds of seed cotton;

The no-fertilizer, no-vetch plots produced 349 pounds of seed cotton per acre.

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Tung Culture in Southern Mississippi

An 11-year-old tung orchard showing good culture and tree development.

Published in cooperation with the Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

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Tung Culture in Southern Mississippi

By

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G. F. POTTER and ERNEST ANGELO[1]

INTRODUCTION

Tung oil, which is expressed from the kernels of nuts borne by the tung tree, **Aleurites fordii,** has been used by the Chinese people for many centuries for waterproofing purposes and in the manufacture of lacquers. In recent years it has been used in America for paint and varnish making and for various other industrial purposes such as the manufacture of linoleum, oil cloth, and printing ink.

Over a period of 4 years, 1937-1940, tung oil importations into the United States average 114,000,000 pounds of tung oil per year, with an average price of 18.3 cents per pound (see figure 1). For the first seven months of 1941, importations averaged 3,500,000 pounds per month at 29.7 cents per pound. During the last 5 months of 1941 there were about 28,000,000 pounds imported into the United States at an average price of 35.5 cents per pound. Prices had increased from 36.4 cents per pound in December 1941, to 40.2 cents in June 1942. In August 1942 the price of tung oil was set by the Office of Price Administration at 39.0 cents per pound, f.o.b. New York City. It has continued at about the same level through 1944, but may be expected to decline after the war.

In 1904 and 1905 the United States Department of Agriculture received tung seed from L. S. Wilcox, consul general at Hankow, China. This seed was planted at the U. S. Plant Introduction Gardens at Chico, California. In 1905-06 and in several succeeding years, seedlings grown from this and other seed were distributed by the Department of Agriculture to State agricultural experiment stations and to many private cooperators in the warmest sections of the United States.

The tung tree requires a long, warm season, yet must have a period of freezing or near freezing weather in the winter; it requires abundant rainfall and does best in an acid soil. The trial plantings quickly showed that the region to which it is best suited in the United States is a belt some 50 to 100 miles in width along the Gulf of Mexico including northern Florida, southern Georgia, southern Alabama, southern Mississippi, southern Louisiana, and eastern Texas. The first commercial orchards were planted in northern Florida, but the industry was soon extended to other states and about 1925 it began to expand rapidly.

The first extensive planting in Mississippi was made about 1925 by Lamont Rowlands near Picayune. Other plantings followed rapidly and in a short time the acreage in Mississippi exceeded that of any other State. According to the Sixteenth Census of the United States, there were some 9,481,143 tung trees in the State of Mississippi in 1940, which was approximately three-quarters of the total number of trees in the United States.

During the 4-year period from 1940 to 1943, inclusive, the domestic production of tung oil was only 13,536,000 pounds or an average of 3.4 million pounds per year (see table 1), which is only about 3 percent of our yearly imports prior to the war. The 1944 crop is estimated at approximately 10 million pounds of oil.

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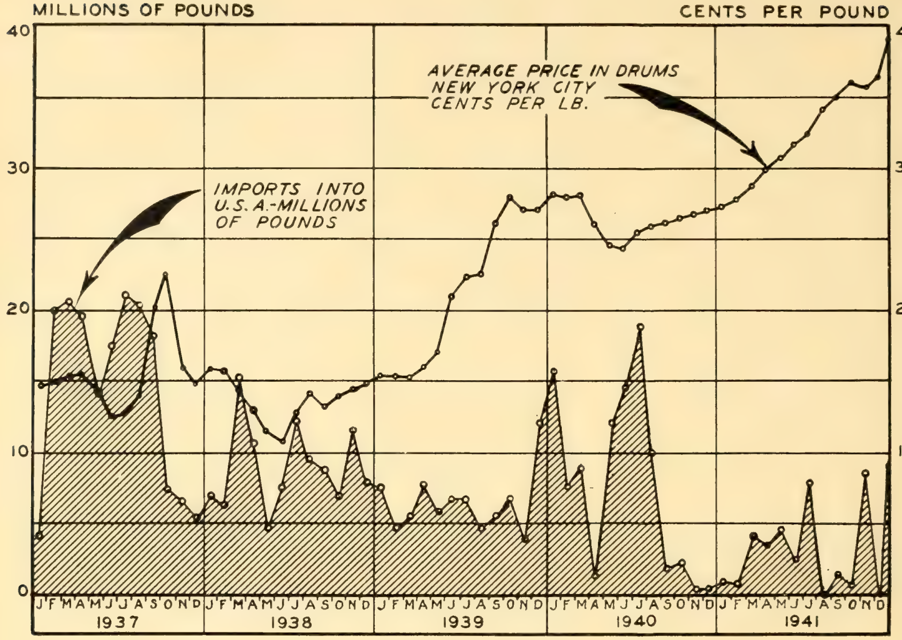

Figure 1. U. S. imports and prices of tung oil, 1937-41 inclusive.

With the present culture and fertilization methods it is unlikely that orchards now planted in the United States will ever produce as much as half of our prewar yearly requirements of tung oil.

Most of the tung trees are in large plantings, on farms devoted to the single enterprise of tung production. In some instances the tung enterprise is combined with beef cattle production. This is advantageous from the point of view of farm management because the tung crop is sometimes destroyed by frost and the cattle enterprise provides an income when the tung crop fails. At certain seasons the cattle may be pastured in the tung orchard. Contrary to the impression of some growers, pasturing reduces tree growth and production to some extent.

Some growers have found that by pasturing the orchard late in the season, grass in the rows of tung trees is kept

Table 1. Domestic production of tung oil in the United States.[1]

	Air-dry fruit					Total production in the United States	
Year	Georgia	Florida	Alabama	Mississippi	Louisiana[2]	Fruit	Oil
	tons	tons	tons	tons	tons	tons	pounds
1940	1,200	4,700	200	3,700	1,200	11,000	3,520,000
1941	650	2,250	350	3,700	1,800	8,750	2,800,000
1942	950	3,700	500	7,200	4,000	16,350	5,232,000
1943	200	700	100	1,940	3,260	6,200	1,984,000
1944[3]	1,000	7,000	1,500	13,000	7,900	30,400	9,728,000

[1] From release by Crop Reporting Board, U. S. Bureau of Agricultural Economics, December 18, 1944.

[2] Includes small quantities of tung nuts produced in Texas.

[3] Preliminary.

down and harvesting of the nuts is facilitated. With good management the combination of the cattle and the tung enterprises works out well. Owners of small farms have sometimes planted rows of tung trees along their fences and thus have derived a very satisfactory cash income. There is now a tendency among owners of general farms to make small plantings of tung. These men are finding it a very satisfactory cash crop.

History of the Experimental Tung Field. The Experimental Tung Field is located 11 miles west of Poplarville, Mississippi, on the Poplarville-Bogalusa Highway. Four hundred and forty acres of land was deeded to the Mississippi Agricultural Experiment Station for research work on tung. This land comprises 14 types of soil, with not more than about 20 acres of any one type in a continuous block. About 70 percent of the entire tract is suitable for growing tung. Including 1944 plantings, approximately 300 acres have been planted to tung trees.

In March 1940, 75 acres were planted with seedling and budded trees, but early that fall a severe freeze caused so much damage that these trees had to be pulled out and the land was replanted to budded trees only. Therefore, the oldest trees were only 3 years old in 1943. This will account for low production in preliminary reports. The experiments comprise cultivation, cover crops, fertilization, varieties, and nursery practices. The nursery experiments concern fertilizers as well as methods and time of budding.

Location of the Orchard

The tung orchard is best located on high, rolling land. During frosty nights in spring or during still, cold nights in winter, cold air tends to drain from the hills to adjacent low lands. Thus, orchards planted on the hills are less likely to suffer from frost injury to the blossoms or cold injury to the trees, than are orchards in a valley or on flat land. The soil should be well drained, yet with good moisture-holding capacity. The tung tree is quite sensitive to a high water table. Where surface or subsoil drainage is restricted, it may survive for a time, only to be killed outright in the first exceptionally wet season. On the other hand, the trees never thrive in a sandy soil that retains only a limited water supply.

A sandy or sandy loam surface soil, underlaid with a friable, sandy clay, gives best results. If the subsoil is well drained and well aerated it will be of uniform color, yellowish, brownish, or reddish, as the case may be, but without distinct mottling. Excessive mottling gives evidence that at some time during the season there is excess water standing in the soil. In all soils of the Coastal Plain, the underlying layers of so-called "parent" material are likely to be mottled, and tung trees have often been planted and have done fairly well with only 24 to 30 inches of well drained, well aerated soil of uniform color above the mottled layer; but for the best results a well developed subsoil of uniform color should extend to a depth of at least 3 to 4 feet.

While tung trees can be grown on rather light and relatively infertile soil, much fertilizer is likely to be needed, yields are likely to be low, and it is doubtful that the enterprise will pay. Soils that have enough fine particles of clay and silt to insure good moisture-holding capacity, will have the additional advantage of greater inherent fertility and also what the soil scientists call greater "base exchange capacity." In simple terms, base exchange capacity is the power of a soil to hold fertilizer that has been applied rather than to let it leach away.

In addition to good drainage, good aeration, reasonable fertility, and the power of retaining fertilizers, the soil should have an acid reaction, preferably pH 6.0 or 6.5, although the tree will tolerate greater soil acidity. A pH 6.5 indicates a soil verging on neutrality in reaction in which certain elements of plant food tend to become less available to the trees. If the reaction is lower than 5.5, leguminous cover crops, which are a mainstay of the tung orchard, are grown with difficulty.

In terms of specific soil series, Ruston, Orangeburg, and Norfolk sandy loams or fine sandy loams are ideal for tung orchards. Although Orangeburg and Ruston are generally rated above Norfolk, instances have been observed in which tung orchards in a Norfolk fine sandy loam are fully equal in growth and production to adjacent orchards on Orangeburg soil of similar texture.

In much of that part of the Coastal Plain area where tung is grown there is but little of the true Ruston, Orangeburg, and Norfolk. Related soil types such as the Pheba, which is similar to the Norfolk in the surface layers but is underlaid at varying depths with a rather compact subsoil, may be used with reasonably good success, provided that the compact layer is not less than 30 to 40 inches beneath the surface. A soil type now known as Ora, similar to Ruston in the surface layer, but underlaid with a relatively heavy subsoil at a depth of 30 to 40 inches, has been found to be a good tung soil. In early soil surveys, Ora soil was often classified as Heavy Ruston. The deep phases of Ora and Pheba seem very satisfactory for tung orchards. On the other hand, soil types such as Caddo or Susquehanna, in which a mottled blue, red, and yellow, sticky, plastic clay occurs close to the surface, should never be planted to tung.

A few orchards have done fairly well on soils that at one time were mapped as Susquehanna, but only where there is a good layer of well developed sandy clay subsoil overlying the sticky, mottled layer. Even if the plastic clay is 24 to 30 inches beneath the surface, it is likely that the trees will decline in vigor and production at an early age. The roots can not penetrate deeply, and as the trees become larger their demand for moisture and for elements of plant food increases, with the result that the shallow surface layer becomes inadequate.

Soil Preparation

With most soils it is impossible to cultivate a tung orchard planted on the square even on comparatively level land, without causing serious erosion during the heavy rainfalls that are characteristic of the tung belt. In some orchards the practice of building terraces between the rows of tung trees has been followed. This is satisfactory while the trees are young, but as they reach maturity and the branches extend outward, terraces between the rows interfere seriously with proper culture.

Workers of the Soil Conservation Service, who have made a special study of orchard culture, recommend planting the trees on the terraces. In that event it is essential that the terraces shall be constructed with wide bases, the slope being so gentle that the tractor and orchard disk may be operated along and close to both sides of the row of trees. Cultivation along the row tends constantly to throw a little more dirt toward the trees, thus building up and maintaining the terraces.

In an orchard it is best to adjust the terrace interval to the desired distance between rows, rather than to construct terraces according to an arbitrary difference in elevation. The terraces may be so spaced that at the steepest point of the slope they will be the exact distance apart that is required between rows of trees; or the distance may be proper for two or more rows of trees. Where the slope becomes more gentle, "point rows" will be planted between the terrace rows.

As cultivation will tend to throw the soil toward the point rows, they may be expected eventually to act as terraces; they must therefore be laid out in such manner that they will drain continuously toward the outlet. This is accomplished by following the rule that as one proceeds towards the terrace outlet, if the terraces diverge, the point row should parallel the lower terrace; if the terraces converge, the point row should parallel the upper terrace. Thus the grade on the point rows will always be either equal to or greater than the grade of the terraces, there will be no shift from downgrade to upgrade, and each point row will eventually discharge into either the terrace outlet or the lower terrace. If the point rows are continuously parallel either to the upper or to the lower terrace, it is inevitable that there will be low points toward which water will drain from both directions and where it will break across the row, causing serious erosion.

In the early days of tung orcharding it was common to plant the trees among stumps. Strips of land along the tree rows were prepared and only those stumps were removed that were actually in the row. Experienced growers now realize that it is cheaper in the long run to remove all stumps before any trees are planted. Stumps interfere with proper orchard culture, increase the operating expense, destroy equipment, and in the end are removed at relatively great expense because the tung trees interfere with the stumping operation. It is reasonably satisfactory to plow and prepare a strip of soil, perhaps 16 to 18 feet wide, for each row; that is 8 to 9 feet on each side of the line of trees. If the stumps have been removed, two or three extra furrows can be turned in each year as the trees increase in size until eventually the whole area is under cultivation.

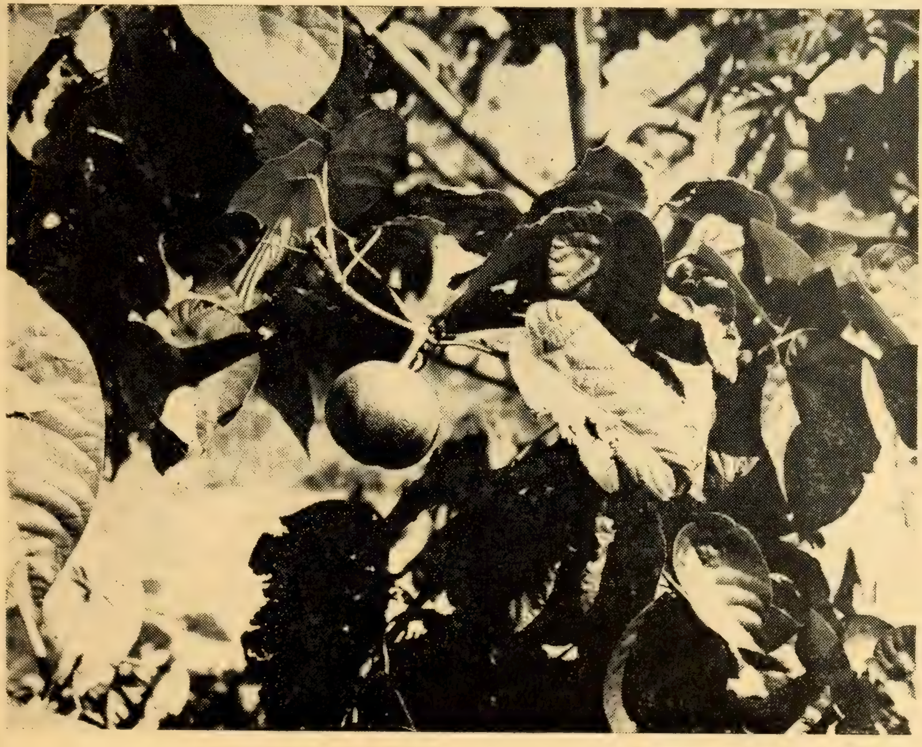

Figure 2. Single-fruiting habit common in seedlings. Produced by a 4-year-old, L-2 seedling, Experimental Tung Field.

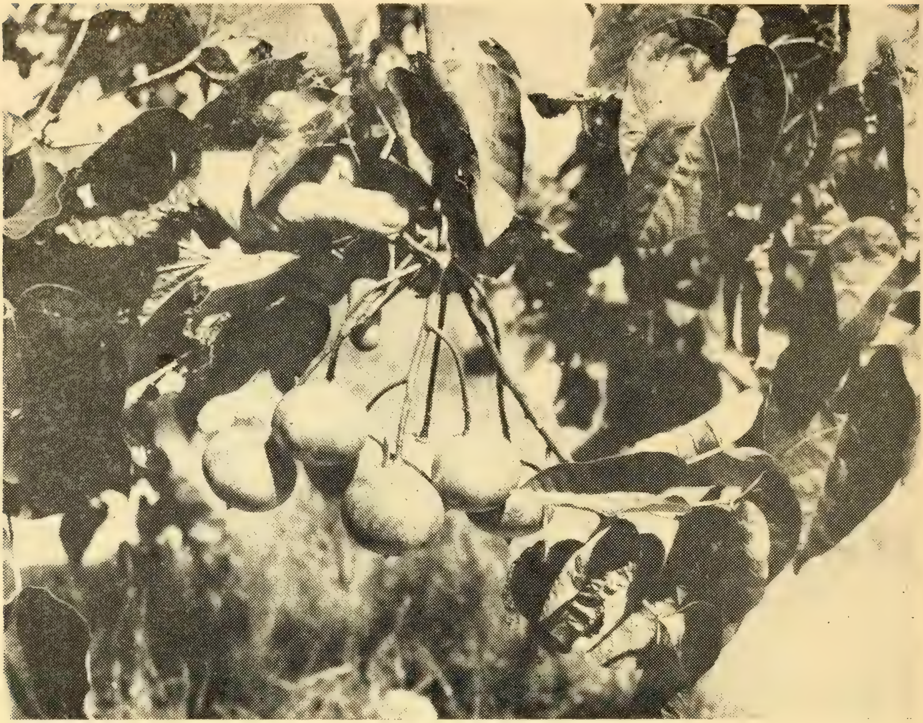

Figure 3. Cluster-type fruiting. Produced by a 4-year-old budded tree, A-4 variety, Experimental Tung Field.

The strips along the tree rows should be plowed and disked thoroughly before the trees are planted.

Planting Stock

An orchard can be established by planting seed in place or by planting out nursery trees. The seeds are slow to germinate, and when the seedlings first come up they make a very slow and weak growth; hence they require close attention and considerable hand work. A nursery tree is of fairly good size to begin with and makes a rapid growth in early spring. Thus most of the work can be done with tractor or horse-drawn tools, with a minimum of work by hand. Although good results may be had by either method, most growers will save money and obtain the most satisfactory results by planting nursery trees.

Whether one plants seeds or nursery trees, it is of the utmost importance to use only the best available strains of tung trees. The trees in commercial orchards vary widely in productivity, oil content, frost resistance, number of fruits per cluster (see figures 2 and 3), tree type, and many other characteristics. Furthermore. one can not be certain that a tree, itself quite satisfactory, will produce uniformly good seedlings. Sometimes the best-looking trees produce variable progenies while other trees produce uniformly good seedlings. Just as stockmen know that the only reliable way to judge a bull is by his calves, so tung growers must learn to evaluate a tung tree by its progeny.

At present there are but few "progeny-tested" tung trees in America, but rapid progress is being made and those desiring the latest information should consult their agricultural experiment stations or the U. S. Department of Agriculture, Field Laboratories for Tung Investigations.

Recently a few budded tung trees have been planted in commercial orchards. On the basis of the laws of heredity and of experience with other orchard trees it is to be anticipated that budded trees will have certain advantages. One named variety of budded tung trees is now on the market and rather extensive experiments with a number of other varieties are in progress. Certain of the newer budded varieties appear very promising as 4-year-old trees.

Table 2 shows production in a test of 26 budded varieties and 2 seedlings. These trees were planted in February 1941, received ½ pound of 8-8-6 fertilizer per tree per year's growth, plus a vetch cover crop fertilized with 300 pounds basic slag, and were clean-cultivated during the summer. On the basis of total yield for two seasons, the five leading varieties were (1) F-99, 1426 pounds per acre; (2) L-2, 1321 pounds per acre; (3) A-4, 1166 pounds per acre; (4) F-4, 1159 pounds per acre; and (5)

Table 2. Yields of air-dry fruit in 1943 and 1944 from a number of varieties of budded tung trees planted in 1941—Experimental Tung Field, Pearl River County, Mississippi.

Variety*	Trees in test	Yield air-dry fruit per tree 1943	Yield air-dry fruit per tree 1944	Total yield air-dry fruit 1943-1944 Per tree	Total yield air-dry fruit 1943-1944 Per acre
	number	pounds	pounds	pounds	pounds
F-99	10	4.0	19.0	23.0	1426
L-2	10	4.4	16.9	21.3	1321
L-2 (seedling)	10	2.5	11.6	14.1	874
A-4	10	4.9	13.9	18.8	1166
F-4	10	1.9	16.8	18.7	1159
L-14	10	4.8	13.7	18.5	1147
L-14 (seedling)	5 1/	1.9	11.7	13.6	843
A-26	10	4.6	12.6	17.2	1066
A-12	8	.8	15.0	15.8	980
F-542	8	4.1	11.3	15.4	955
M-2	9	3.4	11.2	14.6	905
L-9	10	2.5	11.7	14.2	880
M-14	6	2.6	10.9	13.5	837
F-58	9	2.9	10.1	13.0	806
M-1	8	2.3	9.1	11.4	707
F-508	9	1.5	9.6	11.1	688
L-10	9	1.3	9.8	11.1	688
F-507	10	2.6	8.3	10.9	676
F-75	9	2.1	8.7	10.8	670
F-541	10	2.0	8.0	10.0	620
G-40	5	3.9	6.1	10.0	620
F-566	5	2.3	6.5	8.8	546
M-12	7	1.7	6.2	7.9	490
F-555	4	2.7	5.0	7.7	477
L-22	10	1.9	5.7	7.6	471
A-1	10	.6	5.1	5.7	353
G-37	4	1.6	4.0	5.6	347
G-50	4	2.0	1.5	3.5	217

* These are U.S.D.A. selections which have not yet been named. They are designated by an initial indicating the state in which the original tree was found, as for instance, F for Florida, M for Mississippi, etc., and a serial number.

1/ Average of 3 trees in 1944.

Differences of less than 1.6 pounds in the 1943 year or 4.9 pounds in the 1944 year are not significant.

L-14, 1147 pounds per acre. It will be noted that the yield from L-2 budded trees was almost double that from the L-2 seedlings and the L-14 budded trees produced nearly forty percent more than the L-14 seedlings. Yields, oil percentage, and value of production of five varieties of 3-year-old tung trees are shown in table 3. The percentage of oil varied from 21.1 for L-9 to 23.8 for A-12. Variety M-1 produced $11.09 worth of nuts per acre; A-4, $19.02 per acre; L-9, $12.30 per acre; A-12, $10.50 per acre; and F-541, $9.84 per acre. Variety A-12 ran 23.8 percent oil and A-4, 21.2 percent oil; but A-4 gave a return of $8.52 more per acre than A-12, this being due to the high yield of fruit. However, the whole matter of budding tung trees is still in the experimental stage and further observations will be needed in order to determine the relative merits of different varieties and their value in comparison with the best seedling strains.

Stratifying seed and establishing the nursery. The tung seed should be planted on well-drained, sandy loam soil, preferably in a field that is free from weeds. The seed germinate rather slowly, hence the weeds are likely to get a start before the seedlings come up.

"Stratifying" the seed before planting will make them germinate more quickly and more uniformly and thus facilitate weed control. Stratfication is accomplished by hulling out the seed just as soon as they are gathered in the fall and placing them in moist sand immediately. A wooden frame about 12 inches deep, is set up on a well-drained knoll, 2 or 3 inches of sharp screened sand is put in, then alternating layers of seed with ½- to ¾-inch layers of sand to a depth of 5 or 6 inches, after which the frame is filled, covering the last layer of seed with 3 or 4 inches of sand. The seed remain in the moist stratifying bed until the last of February or the first of March.

Planting seed in the nursery. The seed are planted about 2 or 3 inches deep and approximately 1 foot apart in slightly raised beds, with 4 or 5 feet between the rows (see figure 4). For fertilization one can side dress with 200 to 300 pounds per acre of a good mixed fertilizer, such as 5-10-5, as soon as the seedlings are up and one can see the rows. It has been found exceptionally advantageous to use poultry droppings, if available, in the row before planting time. A furrow 5 or 6 inches deep is made, the poultry droppings are strewn in at the rate of about 20 to 25 pounds per 100 feet, after which about 2 inches of soil is filled in and the seed planted directly over the poultry droppings.

The nursery should be cultivated at frequent intervals throughout the season. With good culture the trees will be large enough to bud by the end of August, or to transplant to the orchard during the ensuing winter if they are to be set out as seedlings.

Budding tung seedlings. Since April

Table 3. Yield, value, and oil percentage of tung nuts produced in 1943 by five varieties planted in 1941—Experimental Tung Field, Pearl River County, Mississippi.

Variety	Fruit per acre of 62 trees	Average percent oil[1]	Pounds oil[2] per acre	Price per ton 1943 crop	Value per acre
	pounds	percent	pounds	dollars	dollars
M-1	198	21.2	42.0	$112.36	$11.12
A-4	340	21.2	72.1	111.83	19.01
L-9	220	21.1	46.4	111.83	12.30
A-12	167	23.8	39.7	126.14	10.53
F-541	163	22.8	37.2	120.84	9.85

[1] The percent of oil was determined by Mr. A. F. Freeman, Associate Chemist, U. S. Bureau of Agricultural and Industrial Chemistry, Bogalusa, Louisiana.

[2] The best mechanical tung mills can extract not to exceed 85 percent of the total oil in the fruits.

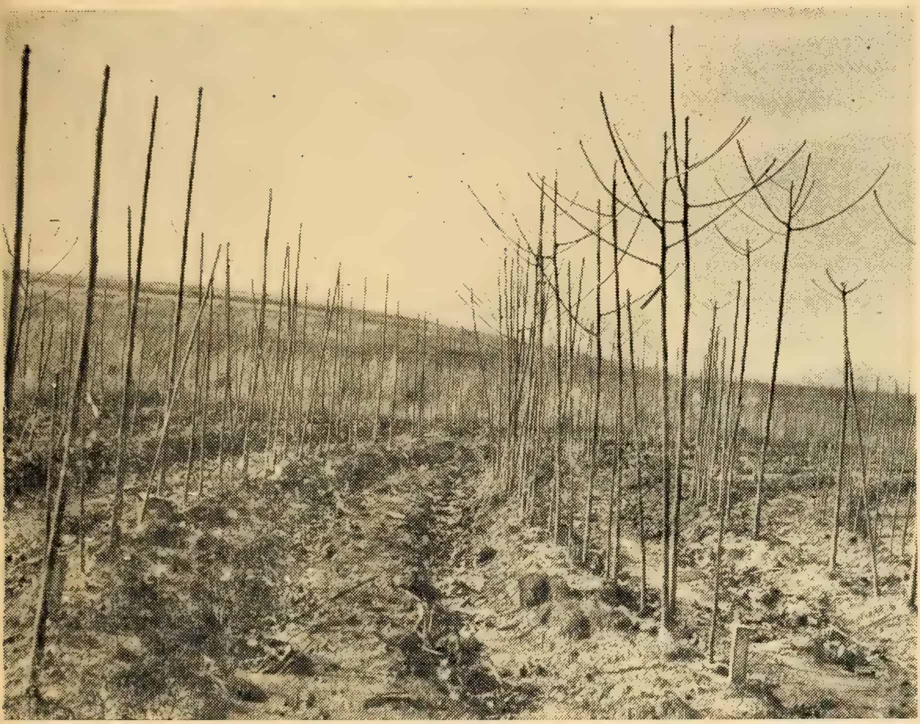

Figure 4. Distinctive types of seedling tung trees in the nursery: Row at the left is from open-pollinated seed of the parent tree F-549; row at the right shows branching, from open-pollinated seed of the parent tree G-54. Seed planted March 1942. Photographed February 1943.

1939, over 78,000 tung seedlings have been budded in experimental and routine work of the U. S. Field Laboratory for Tung Investigations, Bogalusa, Louisiana. Any given lot of seedlings may be budded in late August and September following the planting of the seed (called fall budding), or during the succeeding spring. By late August, buds that have never been exposed to cold weather can be worked on rootstocks grown the same summer. About November 1, well after the close of the normal fall budding season, the dormant buds are banked with earth to protect them from cold injury until the following April. When danger of freezing is over, the earth is removed and the stocks are cut back to force the buds. For 5 to 6 weeks after cutting back, the suckers must be removed from the stocks every week or 10 days, to make certain that only the proper buds grow. The trees are ready to transplant by the succeeding January. They should be fertilized only lightly, if at all, during the season the buds are forced; otherwise they tend to grow too large to transplant readily.

The data comparing spring and fall budding are given in table 4. The results of spring budding are compared in each instance with those for the preceding fall. The 3-year average for fall budding, 80 percent, is slightly higher than for spring budding, 72 percent; and in addition fall budding is more reliable than spring budding, because of the possibility of cold injury to the scion supply and to unbanked stocks during the winter. The question arises as to the best

Table 4. Percentage of buds that grew in tung nurseries at Experimental Tung Field, by seasons, 1939-1943.

Year	Fall buds	Spring buds
	percent	percent
1939-40	90	66
1940-41*	46	—
1941-42	82	73
1942-43	69	76
Average	80	72

*Not included in average because a disastrous freeze occurred November 15-16, 1940. Nearly all budwood that might have been used in the spring of 1941 was killed or severely injured.

time and method of fall budding. Table 5 shows that from the middle of August until about the 10th of September is the most successful time for budding. T-budding (shield budding) and patch budding are the most common methods used, with the T-budding giving a higher percentage "take." There are two varieties of T-budding, namely, upright-T and inverted-T, which averaged about the same percentage "take." However, budders usually prefer the upright-T because it is more easily made than the inverted-T.

Planting the Orchard

The best way to dig trees from the nursery is with a tree digger, which has a heavy U-shaped blade that cuts off the roots 12 to 13 inches below the surface and about 12 inches on each side of the trees. After the blade has been run under the row, the trees can be pulled up with a splendid root system for transplanting. If the digging is done by hand, a good rule is to cut the roots about one foot out from the trunk and to sever the main root about one foot beneath the surface.

Although the tung tree will stand more abuse than most other orchard trees, it is best if possible to plant the trees in the orchard promptly after they are lifted from the nursery. It they are to be transplanted long distances, they should be kept moist by packing in partly rotted hay or some similar material. If the trees are delivered to the orchard before they can be planted out, they should be "heeled in."

The simplest method of "heeling in" is to dig a trench, throwing all the dirt to one side. The trees are then leaned against the bank with the roots in the trench and trunks slanting at an angle of perhaps 45 degrees from the horizontal. Earth is thrown over the roots and packed in among them. In digging the soil to cover the first row of trees, one will open a trench for "heeling in" a second row of trees, this process being repeated again and again.

The recommended planting distance for tung trees is 20 feet apart in the rows, with the rows 35 feet apart, which will give 62 trees per acre. Tung trees are best transplanted in January, February, or early March. Late planting often results in poor stands and unsatisfactory growth.

In planting out the trees it is important to pack the soil firmly around the roots. One should start to tramp the soil as soon as the first shovelful is thrown in.

Table 5. Influence of date and method of budding on livability of tung buds: Experimental Tung Field, 1942.

(Based on 36 replications and a total of 4,320 buds)

Date	Upright-T	Inverted-T	Patch	Date mean
	percent	percent	percent	percent
July 23, 1942	62	55	26	47.67
August 14, 1942	82	82	72	78.67
September 3, 1942	88	89	70	82.33
September 23, 1942	50	51	30	43.67
October 12, 1942	24	30	19	24.33
Method mean	61	61	44	55.33

Differences of less than 8 percent are not significant.

Two men make a good planting team; one holds the tree at the same depth that it stood in the nursery, or possibly 2 to 3 inches deeper, "jiggles" it to settle the soil around the roots, pushes the soil in, under and around the lower roots, with the toe of his boot, and tramps it constantly, while the other man shovels. Two men working in this manner will plant almost twice as fast as one man alone and will do a much better job. Many of the early plantings were made by throwing all the dirt on top of the roots and then tramping it a bit on the top, but in the long run better stands and better growth will be had by doing a good planting job.

Culture

Cultivation of the orchard (see figure 5) and the growing and turning under of green manure crops are essential to success in tung orcharding. One may grow summer cover crops, such as **Crotalaria spectabilis, C. intermedia, C. striata,** alyceclover[1], soybeans, or cowpeas, which are planted in the spring and turned under before harvest (see figures 6 and 7); or one may grow winter cover crops like hairy vetch, Austrian winter peas[2], or wild winter peas[3] (this pea, or a very similar one, is known as the wild winter pea in Mississippi, the Caley pea in Alabama, Singletary pea in Louisiana, and rough pea in Missouri), which are planted in late fall and turned under the succeeding April or May. Data on the yields of a summer cover crop and a winter cover crop are shown in table 6.

Summer and winter cover crops. The cover crop should not be allowed to com-

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[1] Alsicarpus vaginalis.

[2] Pisum sativum var. arvense.

[3] Lathyrus hirsutus.

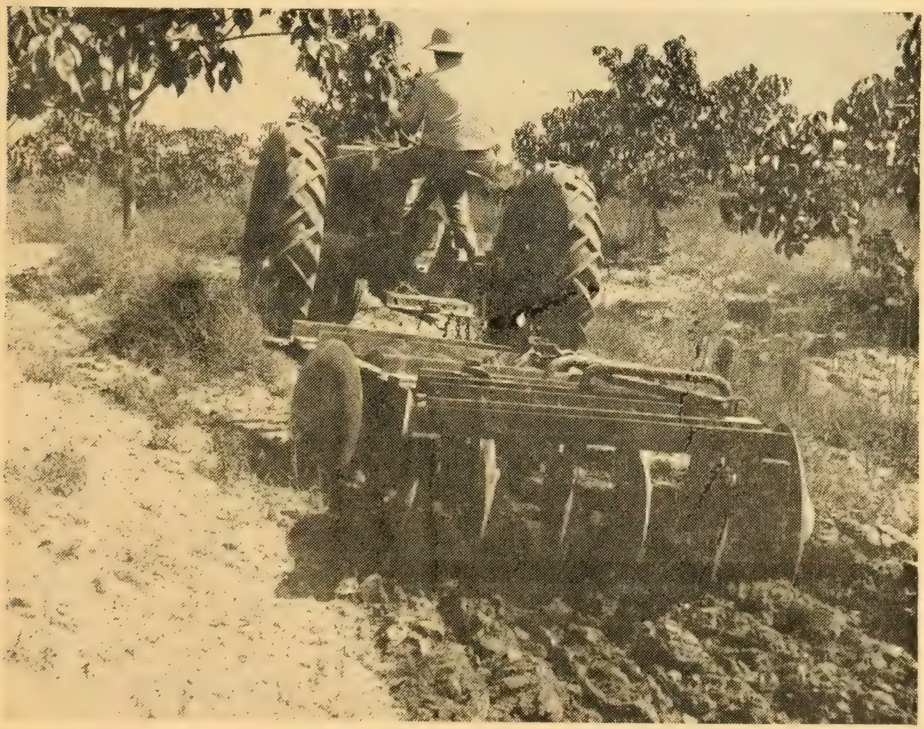

Figure 5. The off-set disk, a valuable implement in cultivating tung trees.

Figure 6. Crotalaria striata cover crop, Experimental Tung Field, 1944.

pete with the trees for mineral nutrients and especially for moisture. As a rule, in south Mississippi the fall months, September to early November, are dry but sometimes there is a drought in March or April. June, July, and August usually have heavy precipitation. Summer cover crops, such as crotalaria may be planted in late May or early June, and will make sufficient growth during the rainy summer months so that an excellent green manure crop may be turned under by the middle of August or the first of September. In order to have the crotalaria reseed, it is necessary to leave a strip 2 or 3 feet wide in each middle. As the seed pods mature and burst, seed will be scattered 10 to 15 feet in all directions. The crotalaria next to the tree row should be disked into the soil while it is still green enough to decompose rapidly.

Alyceclover may be handled much like crotalaria. It should not be planted until hot weather, late June or early July. It will make a good growth before the autumn drought begins and, just as with the crotalaria, the green manure next to

Table 6. Effect of applications of 500 pounds per acre basic slag and of 450 pounds 2-8-4 mixed fertilizer on Crotalaria intermedia and Singletary pea cover crops; Experimental Tung Field, 1943-44.

Treatment	Green weight per acre	
	Crotalaria intermedia	Singletary pea
	tons	tons
500 pounds basic slag	5.74	3.92
450 pounds 2-8-4	1.03	1.70

Figure 7. Alyceclover cover crop, Experimental Tung Field, 1944.

the tree rows should be disked under in August or September. Although alyceclover produces abundant seed, it does not scatter like crotalaria. In order to obtain a stand another year, seed must be harvested from strips left in the middle and used to replant that portion in which the alyceclover was turned down before mid-September.

Cover crop management. If the orchard is in summer cover crop, it should be disked thoroughly at about the same time that tree growth starts in the spring. A second disking will be necessary about the end of May in orchards that are sowed to **Crotalaria spectabilis, C. intermedia** or **C. striata,** and slightly later in orchards in which alyceclover is used as a summer cover crop. Both of these crops grow rapidly only in warm weather. If the land is worked only in early spring, grass and weeds will grow faster than the crotalaria and will choke it out. On the other hand if the weeds and grass are thoroughly destroyed by cultivation in March, April, and May or June, clean stands of crotalaria or of alyceclover will result.

Disking along the tree rows in late summer is essential to prevent undue competition between the tree and the cover crop for moisture and also will provide a clean space on which the fruits may drop and from which they can be readily gathered.

A winter cover crop is advantageous because it makes its growth at a season when there will be little or no competition with the trees. A fairly good seedbed must be prepared, preferably in October. If sown earlier these crops are likely to be damaged by hot weather and nematodes; if sown later they are less resistant to cold weather in winter and the yields may be materially reduced. The weather conditions of the season have a very important bearing on the growth of a winter cover crop. In some seasons hairy vetch, or Austrian or Singletary peas sown in September will do very well. Occasionally, excellent cover crops are obtained from seeding as late as November. However, October seeding will give the best results year in and year out.

The winter cover crop grows slowly during December, January, and early February. With the first warm days of spring it commences to grow rapidly and will continue to do so until hot weather arrives. Yields of 6 tons of green matter to the acre are often obtained by the middle of April or last of May, and the nitrogen in the tops alone may be equal in quantity to the nitrogen in 700 pounds of nitrate of soda per acre. Growth of the winter cover crop may be seriously reduced in the case of a severe spring drought, as in 1944.

The winter cover crop may be disked under after it has nearly completed growth or it may sometimes simply be left as a mulch, allowing the tops to die down and cover the surface of the soil. The orchard need not be cultivated then until grass and weeds begin to come through the mulch. It should then be disked as necessary to keep down crabgrass and other weeds, until in the late summer or fall it is time to prepare a new seedbed for replanting.

As a rule winter cover crops must be planted every year. The wild winter or Singletary pea, reseeds itself and appears rather promising. Some growers report that very satisfactory volunteer stands have been obtained, but others have not been well satisfied. Further experience with this crop must be had before definite seeding recommendations can be made.

Native grasses, lespedeza, alyceclover. Tung trees in orchards that are sodded over with native grasses and lespedeza grow very poorly. Numerous instances have been observed in which the foliage was yellow, the shoot growth was weak, and the crop was below normal. The common lespedeza has an especially bad effect. Under a stand of common lespedeza, soil tends to bake hard, and in consequence most of the water from sudden summer showers drains away. In contrast, alyceclover spreads out, shades all of the surface of the ground, and decaying leaves form of blotter-like layer on the surface. Conditions are ideal to absorb every drop of available water, and the trees have good green foliage, the shoot growth is vigorous, and the trees produce well.

Fertilization of Young Trees

Soils in which tung trees will make a satisfactory growth without applications of fertilizer are exceedingly rare. As a rule it is necessary after the young tree is planted, to apply from ½ to 1 pound of a good mixed fertilizer, such as 6-8-4 or 8-8-6. This should be worked evenly into the surface soil within a radius of 18 inches around the tree, at about the time of year that growth starts. When the fertilizer is applied late, the trees seem to become stunted and there is comparatively little response. Fertilizer applied as late as May or June is probably wasted. The quantity applied should be doubled the second year, and the third year three times as much should be used as at planting time. Most of the soils in south Mississippi, where tung orchards are planted, are exceedingly deficient in phosphorus and this element seems to be especially important when the trees are young. Later, when they are larger and the roots extend through a large quantity of soil, the response to phosphorus is less apparent.

Experiment with fertilizers for tung. To determine fertilization practices most profitably used in tung tree development, an experiment was set up at the Experimental Tung Field, Poplarville, Mississippi, using four elements, phosphorus, potassium, calcium, and magnesium, alone and in all possible combinations. In addition nitrogen was applied uniformly to all plots. Five varieties of budded trees were used: Mississippi No. 1 (M-1), Alabama No. 4 (A-4), Louisiana No. 9 (L-9), Alabama No. 12 (A-12), and Florida No. 541 (F-541). These were planted in the spring of 1941 in Norfolk fine sandy loam soil.

There are 16 treatments and 4 replications of each treatment, with 62 trees per acre. The data are shown in table 9.

Phosphorus especially important. The yields of fruit in 1943 and in 1944 (table 9) show that phosphorus plus nitrogen alone or phosphorus plus nitrogen in any combination with potassium, calcium, and magnesium, has consistently increased production. A-4 responded to phosphorus more than the other four varieties. In 1943 there was an increase of 6.3 pounds of fruit on variety A-4 where phosphorus was used, over those plots where phosphorus was not applied; whereas, the other four varieties gave an increase of only 3.3 pounds of fruit over the no-phosphorus treatments.

Potash and magnesium. While data for the first two years of bearing can not be regarded as conclusive, some effects may be of interest. Potash alone tended to decrease the yield. When magnesium also was applied it offset the injurious effect of potassium, and potassium applied in combination with both phosphorus and magnesium was of some benefit.

Fertilization of mature bearing trees. In mature bearing tung orchards prevailing fertilizer practices are quite variable. Some growers apply as much as a ton of fertilizer per acre per year, while others obtain reasonably good growth and production without using any fertilizer other than that applied on the cover crop at planting time. In most of the soils of south Mississippi, the cover crop will make but little growth unless liberally fertilized with phosphorus. If basic slag can be obtained it should be applied to the cover crop at planting time at the rate of 300 to 500 pounds per acre (table 6). Basic slag is not toxic to the seed or to the inoculation on the seed and may be broadcast and worked in at the time that the cover crop seed is sown.

Lime needed on most soils. If basic slag is not available or if the grower prefers, 500 pounds of dolomitic limestone per acre plus 200 to 250 pounds of 20 percent superphosphate will as a rule give excellent cover crop growth. It is best worked in a week or two before the seed is sown. The tung tree requires a slightly acid soil. On clay soils of south Mississippi, which often have a pH of 4.7 to 5.3, an application of 500 to 1,000 pounds of ground dolomitic limestone per acre will not change the reaction to any great extent; if the applications are continued year after year, the new equilibrium that will be reached is not likely to be too alkaline for tung trees. On sandy soils, of course, the lime will produce a rather marked change in reaction and should be used with caution. The principal ill effect of the lime would be to render elements such as zinc and manganese less available to the trees. This is not likely to occur if the soil reaction is pH 6.0 to 6.5.

Fertilizer for cover crops. As shown by the data in table 6, the basic slag plots produced more than five times as much green weight of crotalaria and two times as much wild winter or Singletary peas as the 2-8-4 plots. The total amounts of phosphorus applied were thought to be nearly equivalent, and evidence from other experiments indicates that the difference may be largely due to the lime in the slag. However, the phosphorus content of slag is often more than the guaranteed amount. No analysis was made, so that more actual P_2O_5 may have been applied in the basic slag than in the 2-8-4 mixture.

The data in table 7 show that an increase in growth of trees occurred where basic slag was used on the cover crop instead of 2-8-4 mixture, also, winter cover crops gave an increase in growth over summer cover crops in both basic slag and 2-8-4 plots. However, several of the plots in which a summer cover crop was planted proved to be rather poorly drained, and the small size of trees in summer cover crop plots as shown in table 7 is due in considerable measure to unfavorable soil.

Fertilization of the cover crop with potassium is also advantageous. Experience and experiments indicate that the yield is improved materially. When phosphorus, potassium, and lime are applied to a cover crop in a tung orchard, a portion of each of these materials is promptly taken up by the roots of the tung trees, and a part is taken up by the cover crop; the leguminous cover crop also has the power to "fix" nitrogen from the air. When the cover crop is turned back to the soil, it decomposes, gradually releasing for use by the trees the phosphorus, potassium, and calcium taken from the soil, and also the nitrogen which has been taken from the air. There are a number of tung orchards in which rather satisfactory growth and production are had simply through the use of one well-fertilized cover crop per year.

Nitrogen helps bearing trees. As shown in table 8, bearing tung trees often respond to applications of nitrogen more than to other elements. Shoot growth is improved, the number of terminal buds per tree is increased, and trees receiving a high level of nitrogen fertilization have been found to produce more fruits in each cluster. Many Mississippi growers apply phosphorus and potassium to cover crops and use nitrogen only for direct application to the trees in early spring. Ammonium nitrate at the rate of 1 to 2 pounds per 6- to 8-year-old tree has been found to produce an outstanding response.

Complete fertilizer. The use of additional fertilizer applied directly to the trees may further increase growth and yields. On light soils as much as a ton per acre is sometimes used. The op-

Table 7. Influence of soil management on growth of young tung trees.[1]

Fertilizer per acre	Kind of cover crop	Diameter of tung trees November 1943			
		Solid cultivation		Strip cultivation	
		Deep cultivation	Shallow cultivation	Deep cultivation	Shallow cultivation
		Inches	Inches	Inches	Inches
Basic slag, 500 pounds	Summer	1.9	1.8	1.5	1.5
2-8-4, 450 pounds	Summer	1.6	1.5	1.3	1.4
Basic slag, 500 pounds	Winter	2.1	2.0	1.8	1.8
2-8-4, 450 pounds	Winter	1.7	1.8	1.7	1.5

[1] Trees planted as dormant buds March, 1942, 10 trees each of M-1, L-2, L-14, F-542. Fertilizer used:500 pounds basic slag versus 450 pounds 2-8-4 on cover crop, plus 1½ pounds 8-8-6 per tree in all treatments.

Table 8. Effect of nitrogen on number of fruits per cluster and on yields in 1942 of tung trees planted in 1934; Lucedale, Mississippi.[1]

Nitrate of[2] soda	Sulphate of[2] ammonia	Fruits per cluster	Increase over check	Yield per tree	Increase over check
pounds per acre	pounds per acre	number	percent	pounds	percent
0	0 (check)	1.94	—	12.3	—
37	60	2.07	7	15.1	23
75	120	2.53	30	17.4	41

[1] Data from experiment conducted at Lucedale, Mississippi, by George M. Bahrt, Associate Soil Technologist, Bureau of Plant Industry, Soils, and Agricultural Engineering, Agricultural Research Administration, U. S. Department of Agriculture.

[2] Fertilizers first applied 1941.

Table 9. Effect of different fertilizer elements on yields in 1943 and 1944 of five varieties of budded tung trees planted in 1941; Experimental Tung Field, Pearl River County, Mississippi.

Treatment	Variety	Fruit per tree		Treatment	Variety	Fruit per tree	
		1943	1944			1943	1944
		pounds	pounds			pounds	pounds
N	M-1	1.8	5.9	NPMg	M-1	4.7	13.2
	A-4	1.8	9.0		A-4	6.5	16.5
	L-9	2.2	9.9		L-9	3.8	15.3
	A-12	0.7	9.4		A-12	3.7	10.9
	F-541	1.0	2.9		F-541	3.4	8.0
NMg	M-1	1.7	5.5	NPCa	M-1	4.7	11.9
	A-4	2.5	16.3		A-4	12.1	18.3
	L-9	1.3	9.6		L-9	4.2	19.9
	A-12	1.6	12.8		A-12	4.9	20.7
	F-541	2.2	6.4		F-541	4.5	13.0
NCa	M-1	1.3	4.0	NPCaMg	M-1	5.3	15.5
	A-4	2.4	10.1		A-4	9.2	17.0
	L-9	0.6	6.0		L-9	3.7	18.5
	A-12	1.0	10.1		A-12	2.2	23.6
	F-541	1.3	2.8		F-541	4.7	12.3
NK	M-1	1.2	6.3	NPK	M-1	5.0	15.5
	A-4	3.3	17.1		A-4	5.9	10.2
	L-9	1.4	10.7		L-9	5.9	23.2
	A-12	1.3	13.7		A-12	3.9	21.9
	F-541	0.3	5.7		F-541	1.4	10.2
NP	M-1	5.6	17.2	NMgK	M-1	1.1	3.7
	A-4	9.7	22.3		A-4	0.4	10.7
	L-9	2.5	15.2		L-9	1.5	4.7
	A-12	3.3	28.2		A-12	0.6	9.3
	F-541	5.2	15.5		F-541	0.7	3.4
NMgCa	M-1	1.8	7.0	NPKCa	M-1	4.6	15.1
	A-4	3.1	13.4		A-4	5.1	14.6
	L-9	3.4	8.4		L-9	6.5	20.7
	A-12	0.8	11.1		A-12	7.8	18.7
	F-541	1.4	5.6		F-541	3.2	9.9
NKCa	M-1	0.5	2.7	NPKMg	M-1	5.5	14.9
	A-4	1.5	6.9		A-4	12.0	14.3
	L-9	1.6	7.9		L-9	7.6	19.4
	A-12	0.5	11.9		A-12	6.3	16.6
	F-541	0.5	4.8		F-541	5.2	13.0
NKCaMg	M-1	1.1	5.9	NPCaMg	M-1	5.2	9.4
	A-4	1.5	16.4		A-4	6.7	20.8
	L-9	3.1	13.6		L-9	8.6	17.1
	A-12	1.4	18.3		A-12	3.1	26.2
	F-541	1.4	7.4		F-541	5.5	13.2

N, nitrogen as sulphate of ammonia; Ca, calcium as ground limestone; Mg, magnesium as sulphate of magnesium; P, phosphorus as sodium phosphate; K, potash as sulphate of potash. All fertilizers were applied at the rate of ½ pound per tree per year's growth except limestone, which was applied at the rate of ¾ pound per tree.

timum rate of application will depend on the soils and economic considerations, but ½ to 1 pound of a good mixed fertilizer, such as 6-12-6 or 5-10-5, per year of age of the tree is often recommended. The intelligent grower will watch his trees for any sign of inadequate nutrition and will adjust his fertilizer program accordingly.

On most soils fertilizers are best applied in early spring, beginning a week or two before the blossom period. A single application will prove best, except on very light soils where it may be an advantage to split the amount between an early spring and a June application.

Effect of fertilizer on oil content. In the test at the Experimental Tung Field, fruit from plots that received potassium was found to contain 1.25 more percentage units of oil than that from plots to which no potassium was applied. Similar results have been observed in other experiments in mature bearing orchards. Nitrogen has been found to slightly reduce the percentage of oil in the kernels, but to increase the percentage of kernel in the whole fruit to such an extent that the oil in the whole fruit is increased by as much as 1.00 percentage unit.[1/] The effect of other elements is negligible.

Pruning

The tung tree requires but little pruning. The prevailing practice among tung growers at the present time is to cut back their seedlings or budded trees at planting time, to a stub 8 or 10 inches high. When growth starts, all but the one best bud are removed, thus forcing the growth into a single shoot. If the cultural conditions and fertilization are satisfactory, this single trunk will branch the latter part of the season in a manner depending on its inherent, hereditary characteristics. Some trees will branch close to the ground and throw out a large number of lateral branches (see figure 8). Others will grow long, tall trunks before sending out a few short laterals (see figure 9). Growers often call trees of this type "natural crown" trees; but the framework of branches of a tree is more properly termed the "head." Hence it is better to refer to such trees as "natural head" trees.

Cutting back to stimulate branching. One great difficulty with this system of training tung trees is that if for any reason the tree fails to send out its lateral branches during the first season in the orchard, a whorl of branches like the spokes of a wheel will come out just at the point where growth starts in the second season. This type of tree, which is known as a "cartwheel," is exceedingly weak and will break down when bearing heavy crops or under stress of windstorms.

If the tree fails to branch during the first season in the orchard, or if it produces a very high head, it is desirable to cut it back to about 24 or 30 inches at the beginning of the second season. All the buds that are forced out above 12 inches from the ground are allowed to grow, forming a sort of vase shaped tree, which is known to fruit growers and horticulturists as a "vase form" tree (see figure 10). Tung growers sometimes call it a "bush" tree. Recent experiments show that during the early life of the tree these vase form trees made more growth and produced more fruit than the high headed trees. In one experiment, trees pruned to a vase form in the spring of 1940 now have about twice as much bearing wood as the trees pruned to the so-called "natural head." Some growers are concerned lest the vase form trees shall be more difficult to cultivate than those with the natural head. Actually, the branches tend to be more upright than those of the natural head tree and with the proper type of offset orchard disk harrow, no difficulty from this cause will be experienced.

[1/] Nitrogen promptly increases yield of tung oil. B. G. Sitton and A. J. Loustalot. Proc. Amer. Tung Oil Assoc. 1945 (in press).

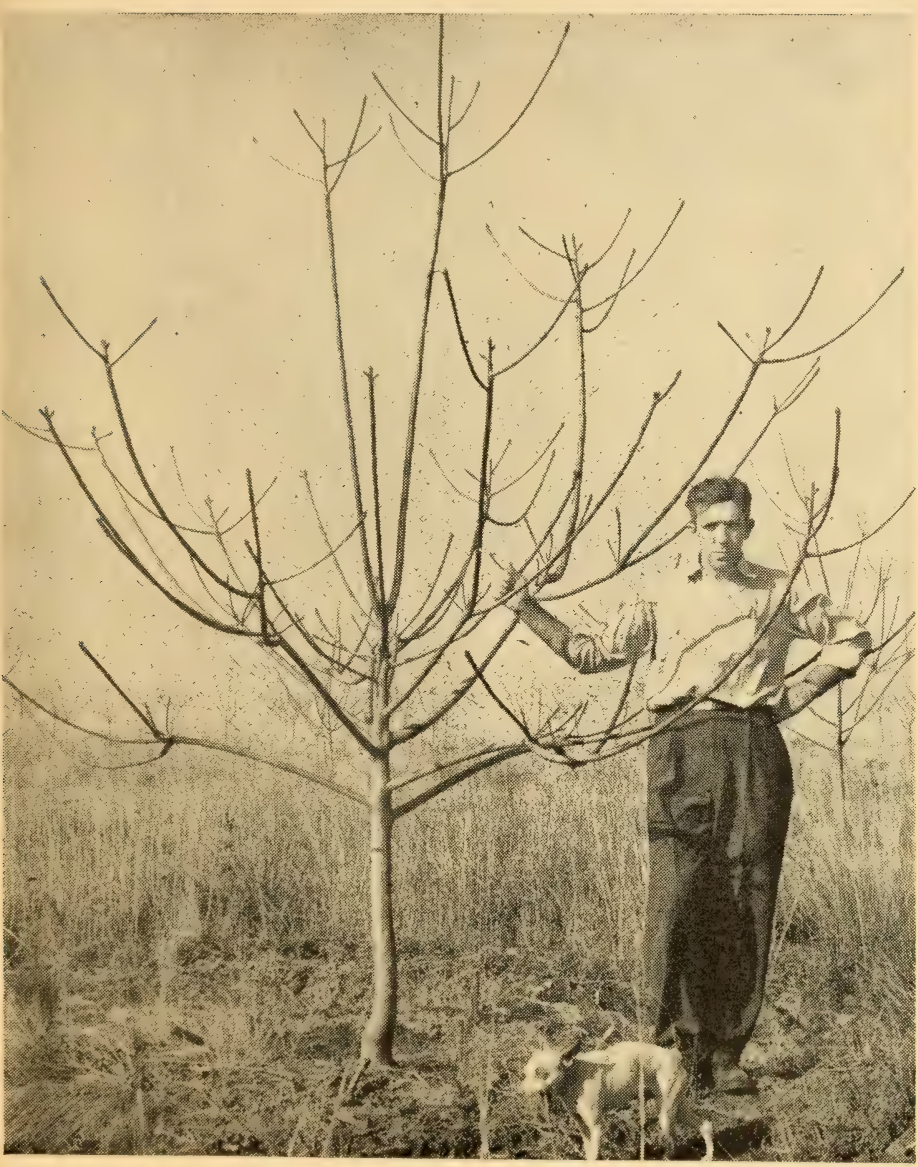

Figure 8. Budded tung tree of the variety L-14, planted in February 1941 and photographed 2 years later. At planting the trunk of the tree was cut back to about 10 inches from the ground, and when growth was started all buds but one were rubbed off. No further pruning or training was practiced. This variety is one that develops a satisfactory tree by this method, but many other varieties have different growth habits and require more pruning for best results.

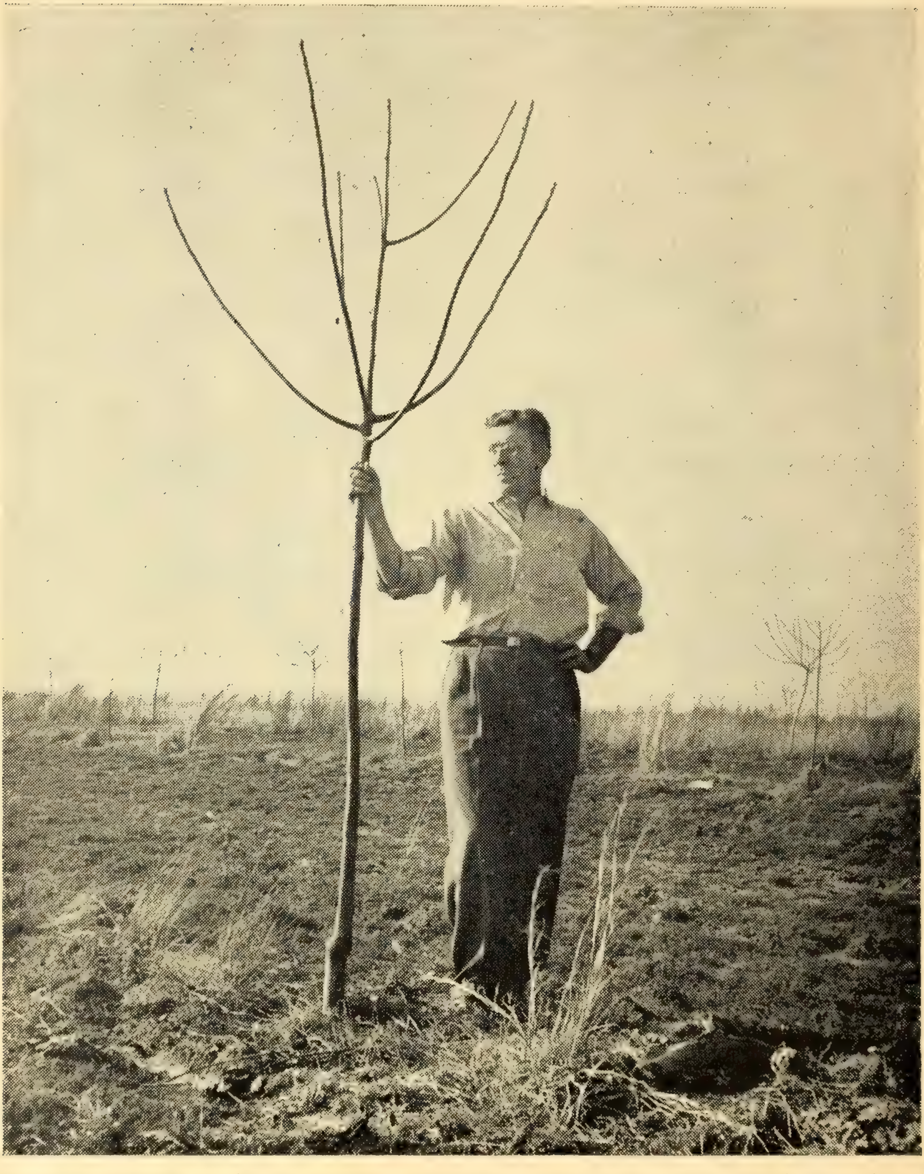

Figure 9. Budded tree of variety A-13, planted in March 1942, cut back close to the ground, and one bud allowed to develop. Photographed February 1943. This variety develops a fairly satisfactory head but the branches are too far from the ground. Trees of this type can be improved by making cuts above the buds that are found along the trunk below the branches.

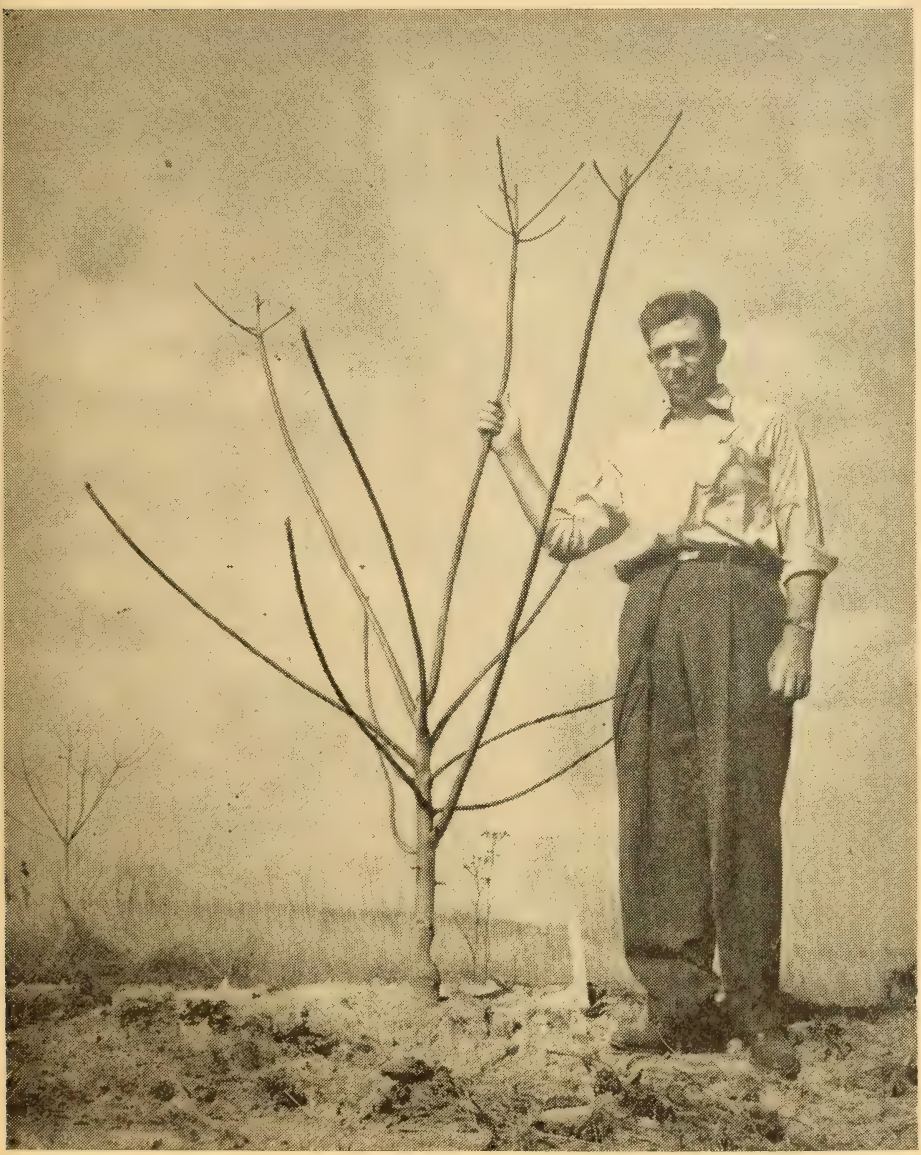

Figure 10. Budded tung tree of the variety F-507, planted in February 1941 and photographed 2 years later. It was developed by cutting back the single trunk to a height of about 30 inches and subsequently allowing all buds to develop. This is the "vase" or "bush" type tree, preferable to that shown in figure 9, but not so desirable as that shown in figure 8.

After the head is formed little or no pruning is required. Those who insist on high-headed trees will have to remove suckers; vase form and low-headed trees seldom throw out suckers.

Notching to stimulate branching. Another method of improving naturally high-headed trees is by cutting notches above the lateral buds on the trunk, early in the second growing season, thus forcing out additional branches on the lower part of the trunk. The notches may be made with a saw or knife. If a knife is used, two horizontal parallel cuts about ¾ to 1 inch long and about ⅛ to ¼ inch apart are made, the lower one about ¼ inch above the bud. The knife blade must go clear through the bark to the wood. The notching is best done at about the time growth starts, but is sometimes effective as late as June. In some seasons the buds force much more readily than in others, and to insure success, pruning back the branches of the original high head is advisable.

Harvesting and Storing Tung Fruits

Tung fruits begin to fall in late September or early October and are all on the ground soon after the first heavy frost of the season (see figure 11). The fruit is allowed to remain on the ground for 4 to 6 weeks or until it has dried sufficiently for the outer covering or hull to become hard. Harvesting is done by hand. The workers are paid by the bushel at a price ranging from 5 cents to 15 cents per bushel hamper, depending

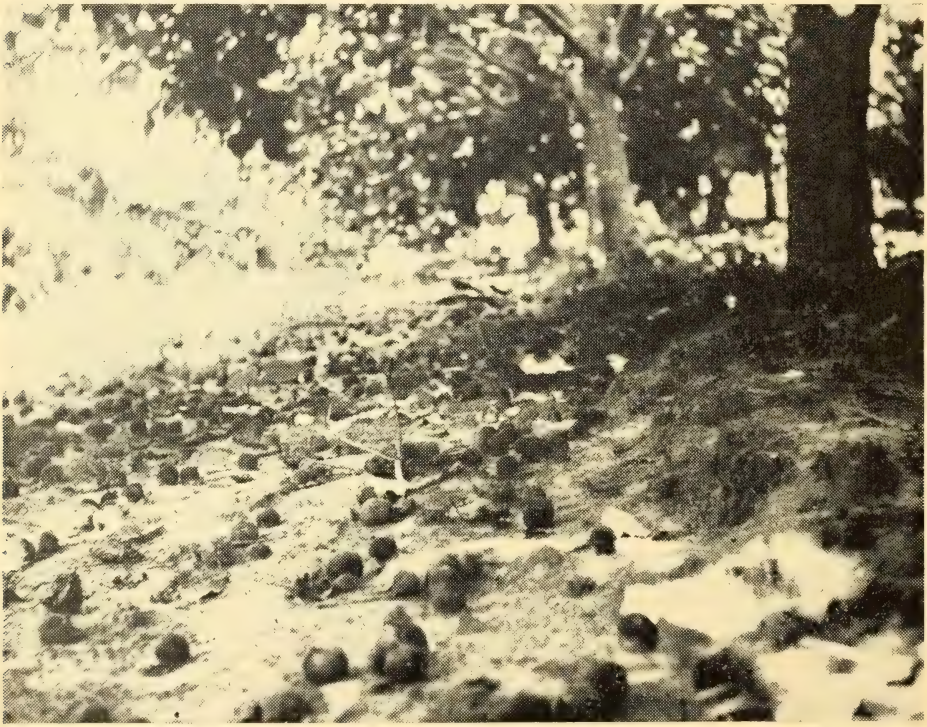

Figure 11. Eleven-year-old seedling trees, about half of fruit on the ground, October 4, 1944. The tung fruits drop to the ground when mature, and are gathered by hand after drying 4 to 6 weeks. This photograph and the tung orchard scene on the front cover, were taken at the J. R. Rankin farm, Poplarville, Mississippi.

on the tonnage per acre (one ton equals about 80 bushels).

After the fruits are gathered in baskets they may be transferred to sacks and hung in the trees for a week or two, or immediately transferred to a drying shed or storage bin. These drying sheds are nothing more than a frame building with siding and flooring spaced sufficiently to allow free circulation of air. If the fruits are to be stored at great depth, that is 15 to 20 feet, it is advisable to space the studding and floor joists at 1-foot intervals and to use ½-inch hardware cloth instead of 1-inch boards. The fruits may be put in and taken out of these bins by conveyors, or the bins may be constructed on a hillside so that the loading and unloading may be done by gravity. Growers must be cautioned against filling storage bins with green or wet fruit. Unless the fruits are rather dry, bins must be filled gradually, allowing each layer of 12 to 18 inches to dry out before adding more. The fruit is left in the storage bins for 6 weeks or 2 months or until the moisture content is reduced to approximately 12 percent or less, when the nuts are ready to deliver to the crushing mill. Drying equipment recently developed and installed may enable the mills to process fruit as gathered in the orchard.

Summary

During the four years prior to the attack on Pearl Harbor (1937-1940), American imports of tung oil averaged 114 million pounds per year. For the 4 years 1940-43 inclusive, the total domestic production was only 13,536,000 pounds, or an average of 3.4 million pounds per year. The estimate for the 1944 crop is approximately 10 million pounds, which is less than 10 percent of the prewar imports.

Selection of orchard site is the most important factor in establishing a tung orchard. It should be on high, rolling land. Ruston, Orangeburg, and Norfolk sandy loam and other similar soils are among those most suitable for tung. The land should be terraced and the trees should be planted on the terrace ridges.

Tung seed should be planted in a nursery instead of in place on the orchard site. Stratify seed for planting.

In removing trees from the nursery, dig them with good root systems and plant immediately if possible; otherwise heel them in until they are planted in the orchard. Trees should be planted in the orchard at the same depth that they stood in the nursery, or 2 or 3 inches deeper. Tramp dirt firmly around the roots. Plant the trees in January, February, or the first 10 days of March.

Summer and winter cover crops are very important in production of tung; **Crotalaria intermedia, C. spectabilis, C. striata,** or alyceclover for summer cover and Austrian winter peas, hairy vetch, or Singletary peas for winter cover.

The summer cover crop should be turned under in early fall to prevent it from competing with the trees for moisture. Orchards in which a summer cover crop is planted must be cultivated thoroughly in the early spring months; those in which a winter cover crop is planted need thorough cultivation during the summer months.

At planting time ½ pound per tree of a good mixed fertilizer, high in nitrogen, should be applied and during the succeeding 3 or 4 seasons the amount should be increased by ½ pound per tree each year. Phosphorus is very effective at planting time and during the early bearing stage, in increasing growth and yield.

Although good production may frequently be had in mature bearing orchards when no fertilizer is used other than that applied to the cover crop, additional amounts of nitrogen, phosphorus, and potassium, applied just before blooming time, may greatly increase yields. Trees carrying heavy crops must be well fertilized to keep them in vigorous growth. Nitrogen is most important for use in mature bearing tung orchards; it increases the yield of air-dry fruit and also increases the percentage of oil in the whole fruit. Potassium increases oil content on a whole fruit or per ton basis.

Very little pruning of tung trees is necessary after the head or framework of branches is formed.

It is necessary that tung nuts be stored a sufficiently long time to allow them to become air-dry before milling.

Bulletin 410 November 1944

Feeding Pigs for the Home Pork Supply

Pigs fattening on pasture with grain ration and protein supplement at Delta Branch Experiment Station, Stoneville.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

FEEDING PIGS FOR THE HOME PORK SUPPLY

By P. G. BEDENBAUGH

In the selection of a normal diet for humans, it is a well established principle of nutrition that meat is one of the essential foods. Pork is the most widely used meat in Mississippi. There are many reasons why Mississippi farmers should produce more hogs.

Swine producers of Mississippi probably raise only about 65 percent of the pork consumed within the State. Such a situation is a challenge to the farmers to produce more pork for local consumption. There is a market at all times for surplus hogs. With the proper planning of feed and forage crops, pork can be economically produced in Mississippi. The hog can utilize to advantage more different kinds of feed stuffs than any other farm animal, and farmers of Mississippi will find pork production profitable largely to the extent that they utilize home-grown grain and forage crops.

Every farmer must be his own judge in the matter of how many hogs may be kept profitably. The farmer who rushes into the business on account of high pork prices and overstocks his farm, is usually found eventually feeding his hogs at a loss. The farmer who grows his own feed is in a much better position to feed hogs, and a few pigs might be kept profitably on some farms where they do not find a place today.

It is the purpose of this bulletin to aid Mississippi farmers to increase production profitably, mainly by better utilization of actual and potential feed resources. A number of experiments conducted over a period of years are reviewed, and research information is given on four phases of pig feeding thought most important under Mississippi conditions. These are (1) more efficient use of corn by the feeding of protein supplements; (2) the use of pasture or green grazing crops while feeding concentrate feeds; (3) crops other than corn efficiently used in pork production; and (4) conserving war-scarce labor by the use of crops suitable for hogging-down or hogging-off.

It is hoped that the farmer may select practices best applicable to his own situation, not only for the finishing of pigs during the current year, but also practices that will aid in planning an efficient year-round hog production program.

Balancing the Swine Ration

Corn is the principal concentrate feed used for fattening pigs throughout the United States. It contains large amounts of carbohydrates but relatively small amounts of protein. In somewhat the same class are oats, wheat, and barley; these, however, carry a relatively higher percentage of protein than corn. At the other extreme, tankage, shrimp meal, soybean meal, cottonseed meal and other protein concentrates contain large amounts of protein but relatively small amounts of carbohydrates.

Exact requirements vary somewhat with the different animals, but all require definite proportions of protein and carbohydrates as well as a plentiful supply of minerals and vitamins. A balanced ration is a mixture of the several ingredients which supplies all the body needs. In the case of swine, supplying a balanced ration is not difficult; simple mixtures or supplements usually suffice, and the pig will do a good job of balancing his own ration if the necessary variety of feeds is kept available in self-feeders.

In areas where corn is plentiful and relatively cheap, as in the Midwest, corn fed to pigs is supplemented with a protein concentrate because of the large saving made in the total amount of feed required. Making the corn go further in this manner is especially advantageous in Mississippi, where corn is seldom produced in adequate quantities.

Protein Supplement for Corn

The distinct advantages of a liberal use of forage crops, and the value of a protein supplement for corn for pork production, have been definitely established by the various experiment stations. However, in spite of our possibilities for grazing crops, too many pigs are still fed in Mississippi on corn alone in dry lot. Therefore, the following account of corn and protein supplement versus corn alone in pork production, is pertinent.

In 1928, at the Mississippi Experiment Station, six pigs of the same litter were used in a feeding test. This test was conducted to demonstrate the value of a supplement to corn in pork production.

Three pigs were fed corn alone in dry lot for a period of 199 days, while the other three pigs of the same litter were fed corn, tankage, and allowed the run of Bermuda grass pasture. The results of this feeding test may be seen in table 1.

In this demonstration 100 pounds of tankage, valued at $4.50, plus Bermuda grass pasture, saved 1722 pounds of corn, or $30.65 when corn is valued at $1.00 per bushel. Therefore, $4.50 invested in tankage plus Bermuda grass pasture netted a saving of $26.50.

Dairy farmers who have skim milk available for feeding hogs will find it entirely satisfactory as a substitute for tankage when fed in proportions of 3 to 5 pounds of skim milk to each pound of grain.

Numerous other experiment stations have conducted somewhat similar tests and have secured approximately similar results. The Illinois Agricultural Experiment Station Bulletin 395, "Feeding Hogs in Illinois," summarized 23 tests conducted in 8 states, as follows: 12 by the Ohio Station, 3 by the Kansas, 2 each by Nebraska and Michigan, and 1 each by Indiana, Iowa, Alabama, and Mississippi. Results are shown in table 2.

The value of tankage as a protein supplement to corn was clearly shown in these 23 tests conducted in 8 states. Light pigs fed on corn alone required 581 pounds of feed for 100 pounds of gain; when the corn was supplemented by tankage, 100 pounds gain was made on 350 pounds of feed; and every 100 pounds of tankage fed saved 642 pounds of corn. Heavy pigs fed on corn alone required 537 pounds of feed for 100 pounds gain; but pigs fed corn and tankage gained 100 pounds on 410 pounds of feed, and every 100 pounds of tankage fed with corn saved 374 pounds of corn.

Pasture or Green Grazing Crops

Green grazing crops for hogs are divided into two classes, (1) permanent pastures, and (2) temporary grazing crops. The use of temporary grazing crops

Table 1. Feeding corn alone in dry lot versus corn and tankage on Bermuda grass pasture

Lot number	1	2
Ration self-fed free choice	Corn and tankage	Corn alone
Pasture	Bermuda grass	Dry lot
Number of pigs	3	3
Days on feed	199	199
Average initial weight, lbs.	65.33	68.66
Average daily gain, lbs.	1.55	.58
Average final weight, lbs.	375.33	185.33
Feed consumed per 100 lbs. gain:		
Corn	394.0	692.5
Tankage	17.3	
Total	411.3	692.5
*Feed cost per 100 pounds gain	$ 7.79	$ 12.32

*Corn valued at $1.00 per bushel, and tankage at $4.50 per hundred weight.

Table 2. Value of tankage as a supplement to corn: 23 tests in 8 States

	Light pigs in dry lot		Heavy pigs in dry lot		Light pigs on pasture	
	Corn	Corn and tankage	Corn	Corn and tankage	Corn	Corn and tankage
Number of tests	6	6	8	8	9	9
Total pigs	24	29	69	69	77	79
Average number days in test	102	102	84	84	113	110
Average initial weight, lbs.	63	62	132	134	52	52
Average final weight, lbs.	116	186	223	267	161	199
Average daily gain, lbs.	.54	1.16	1.04	1.56	.57	1.34
Average daily ration, lbs.:						
Corn	3.10	3.80	5.63	6.35	3.96	4.63
Tankage	----	.40	----	.54	----	.27
Feed for 100 lbs. gain, lbs.:						
Corn	581	350	537	410	409	345
Tankage	----	36	----	34	----	20
Corn saved by 100 lbs. tankage, lbs.	----	642	----	374	----	320

should be practiced to the maximum extent because of higher yields of pork from concentrate feeds used, as well as because rotational grazing provides more protection from internal parasites and diseases than when the hogs are kept on permanent pasture.

Young fattening hogs make faster and cheaper gains when they have access to good, tender, palatable grazing crops. Grazing crops will reduce the cost of maintaining the breeding stock and increase the growth and vigor of young pigs.

No one system of grazing crops will be practical under all conditions. Each farmer will have to work out a system that will suit his own conditions. The Mississippi Experiment Station has found the small grains to be the most dependable and satisfactory grazing crop for furnishing fall and winter grazing. Oats, wheat, or rye, seeded in the fall will usually furnish grazing from the latter part of November on out into the spring.

Sudan grass seed may be planted as soon as danger of frost is over. This will furnish good summer grazing. Sudan grass should be mowed occasionally so as to keep the grass young, tender, and palatable. Soybeans provide a large amount of excellent forage, but must be allowed to make considerable growth before grazing starts. Where it can be grown, alfalfa is probably the most ideal grazing crop for spring, summer and fall.

When it is not practical to provide a year-around system of temporary grazing crops, a combination of permanent and temporary pasture should be provided.

Pigs fed on pasture require less grain or carbohydrate feed to produce 100 pounds gain than do those fed in the dry lot. Because of the richness in protein of the common grazing crops, only about half as much protein supplement is required as when pigs are fed in dry lot. When the amount of grain fed is limited and the grazing is good, less than half as much protein supplement is required as when pigs are fed in dry lot.

Methods of Feeding While Grazing

Full-fed pigs make faster gains, and are, therefore, ready for market in less time. For spring pigs this usually means a more attractive price. The higher selling price may offset the saving in feed cost by limiting the grain fed, when spring pigs are being finished for marketing purposes.

Full-Feeding vs. Limited Feeding

Mississippi is not a surplus pork producing state. Therefore, attention should

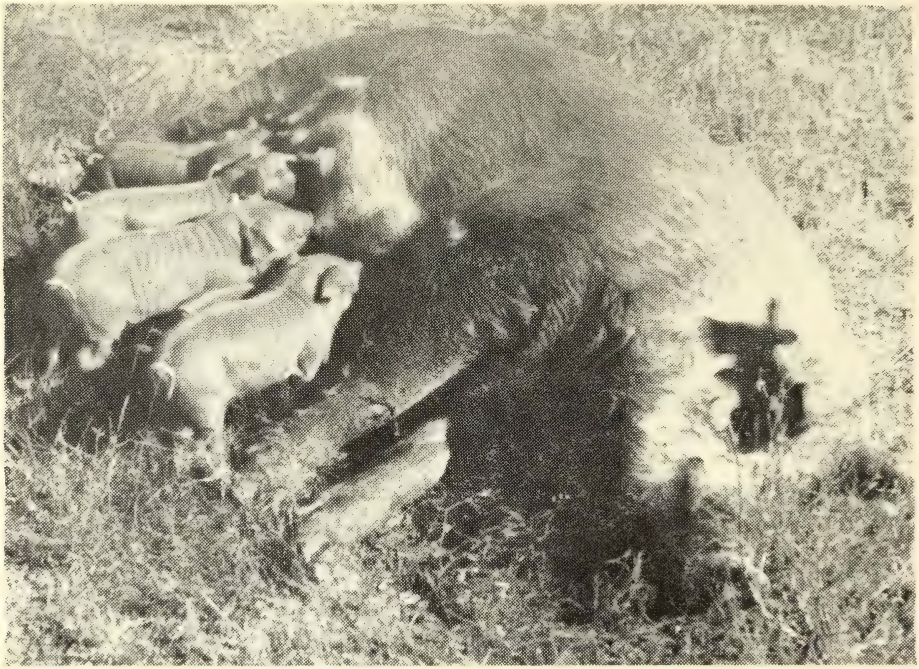

Figure 1. A good type of sow and litter for the home pork supply.

be given to the production of an adequate supply of pork for home consumption. The limited-feeding method provides economical feeding possibilities with the usage of spring farrowed pigs to be slaughtered on the farm during November, December, and January for home consumption or for sale on the local markets.

In one experiment conducted with young fattening hogs in 1936, green soybean pasture saved 42.79 pounds feed per 100 pounds of gain as compared to fattening in dry lot. This was a saving of approximately one-eighth of the carbohydrates feed cost, and at the same time a saving of about one-half of the high priced protein supplement. The above may be noted by comparing the feed consumption per 100 pounds of gain in lots 1 and 2, table 3.

It will be noted in table 3, that the pigs grazing soybean forage in lots 3 and 4 consumed only about 70 percent as much feed per unit of gain as the pigs fed in lot 1 and kept in the dry lot on self-feeder. Lot 3, getting the protein supplement of animal origin in addition to the vegetable protein supplement, made 9 percent faster daily gain and consumed 9 percent less feed per unit of gain than the pigs in lot 4 receiving protein supplement of vegetable source alone.

A comparison of full-feeding and limited feeding is also made in this test. Lot 2 received all it wanted from the self-feeder, while lot 3 received the same feed, but the amount was limited by hand feeding. The full-fed lot required 304.8 pounds of feed per 100 pounds gain, while the lot whose feed was limited required 245.6 pounds per 100 pounds gain, a saving of 59.2 pounds of grain on each 100 pounds of pork produced.

It must be remembered that the pigs in lots 3 and 4 were not finished when the test ended October 5. Pigs of this kind will average approximately 2 pounds daily gain until finished if allowed to hog-down soybeans and corn. Experiments conducted at the Mississippi Experiment Station have shown this to be an economical method of finishing heavy weight feeder pigs. Similar tests have shown that it is usually most economical to gather the corn and graze the beans, hand-feeding corn in liberal amounts.

Fattening Pigs on Dry Lot vs. Wheat Pasture

Three tests were conducted in which comparisons were made both in dry lot and on pasture, of rations composed of corn and protein supplement from plant sources and animal sources. These tests were conducted in the winter of 1936, 1937, and 1938. Fall farrowed pigs were used in these tests.

Three rations were fed, in dry lot and on pasture, as follows: Lot 1, self-fed on dry lot, ground corn 85 parts and ground Mammoth yellow soybeans 15 parts by weight. Lot 4 was self-fed the same ration and allowed to graze on green wheat pasture. Lot 2 was self-fed on dry lot, ground corn 85 parts, ground Mammoth yellow soybeans 10 parts, and 5 parts cottonseed meal by weight. Lot 5 was self-fed the same ration and allowed to graze green wheat pasture. Lot 3 was self-fed on dry lot, ground corn 92 parts and tankage 8 parts by weight. Lot 6 was self-fed the same ration and allowed to graze green wheat pasture.

It may be seen from table 4 that more

Table 3. Feeding pigs on green soybean pasture, July 13 to October 5, 1937

Lot numbers	1	2	3	4
Ration	Self-fed — Ground corn 10 parts, and 1 part each cottonseed meal and shrimp meal until pigs reached an average of 100 lbs. each. From 100 pounds average liveweight until finished, self-fed ground corn 16 parts and 1 part each of cottonseed meal and shrimp meal.	*Hand-fed 2½ percent ration of ground corn 20 parts and 1 part each cottonseed meal and shrimp meal until pigs reached an average of 100 lbs. From 100 pounds average liveweight until finished, self fed ground corn 30 parts, and 1 part each of cottonseed meal and shrimp meal.	Ration same as lot 2, but hand-fed 2½ percent ration during both periods.	*Hand-fed — 2½ percent ration of ground corn 8 parts and 1 part cottonseed meal until pigs reached an average of 100 lbs. each. From 100 pounds average liveweight until test completed, hand-fed 2½ percent ration of ground corn 12 parts and 1 part cottonseed meal.
Pasture	Dry lot	Grazing green soybean forage	Grazing green soybean forage	Grazing green soybean forage
Number of pigs	10	10	10	10
Days on feed	85	85	85	85
Av. initial wt., lbs.	57.46	55.86	57.46	58.06
Av. daily gain, lbs.	1.67	1.66	.99	.90
Av. final wt., lbs.	199.66	197.07	141.46	134.33
Feed consumed per 100 lbs. gain	347.67	304.88	245.67	262.77
Mineral consumed per 100 lbs. gain	1.19	1.41	3.45	4.98

All lots were self-fed a mineral mixture composed of 5 parts each of oystershell flour and steamed bonemeal plus 1 part salt.

*The amount of feed fed daily was 2½ percent of the weight of the pigs in that lot; the feed was divided into 2 feedings, fed night and morning.

rapid gains and less feed consumption per unit of gain resulted from fattening pigs on wheat pasture as compared to dry lot feeding.

By comparing the feed consumption per hundred pounds of gain in lots 1 and 4 it will be noted that the wheat grazing in lot 4 saved 15 percent feed per unit of gain.

Another interesting phase of these results is that the pigs in lot 4 consuming corn and soybeans plus grazing made more rapid gains and consumed less feed per unit of gain than the pigs in lot 3 consuming corn and tankage in dry lot. Soybeans and wheat grazing proved to be an excellent source of protein for fattening pigs.

Wheat Shorts for Feeding Pigs

Evidence indicates that wheat shorts, or middlings, is popular as a feed for supplementing corn in feeding pigs on Mississippi farms. Without a doubt, many farmers who are feeding only a few pigs for the home pork supply are practicing feeding wheat shorts alone when the corn supply is exhausted. Also, a common practice is to supplement corn with wheat shorts when the corn supply is limited.

Wheat shorts contain about ten times as much calcium as corn. However, there is still need of an additional amount of calcium in the ration when feeding wheat shorts alone to pigs. Feeding trials conducted at various experiment stations have shown that it is profitable to add some protein supplement to a corn and wheat shorts mixture, and especially important when pigs are fed this mixture on dry lot.

A summary of one feeding trial conducted at the Mississippi Experiment Station using wheat shorts alone, and a mixture of equal parts corn and wheat shorts by weight, with green wheat grazing is given in table 5.

The mineral consumption per unit of gain in lots 2 and 3 as compared to lot 1 indicates the need of additional calcium when feeding wheat shorts on non-legume grazing.

In this one test, the feed requirement per unit of gain was about the same in each lot. However, the rapidity of gains and higher flesh condition, or finish, was very much in favor of lot 1.

Feeding Cottonseed Meal to Pigs

Cottonseed meal is the most valuable protein concentrate produced in Mississippi. Its availability to Mississippi farms makes it an important concentrate to use in livestock rations.

Table 4. Fattening pigs on 3 rations, dry lot vs. wheat pasture, average of three feeding trials

Lot No.	1	2	3	4	5	6
Ration self-fed	Corn 85 lbs. soybeans 10 lbs.	Corn 85 lbs. soybeans 10 lbs. cottonseed meal 5 lbs.	Corn 92 lbs. tankage 8 lbs.	Same as lot 1	Same as lot 2	Same as lot 3
Pasture	Dry lot	Dry lot	Dry lot	Grazing green wheat	Grazing green wheat	Grazing green wheat
No. of pigs	8	8	8	8	8	8
Days on feed	70	67	62	61	56	54
Av. initial wt., lbs.	98.62	97.76	98.37	95.65	94.36	95.56
Av. daily gain, lbs.	1.46	1.54	1.63	1.72	1.76	2.02
Av. final wt., lbs.	199.38	200.82	198.64	200.07	192.62	203.82
Feed consumed per 100 lbs. gain	378.72	378.56	357.71	321.60	346.36	345.35
*Mineral consumed per 100 lbs. gain	4.11	4.51	2.02	2.37	2.20	1.29

*Mineral mixture: Self-fed 5 pounds each of oystershell flour and steamed bonemeal plus 1 pound salt.

Table 5. Feeding wheat shorts to pigs, March 25 to April 22, 1940

Lot No.	1	2	3
Ration self-fed	Ground corn 85 tankage 7½ cottonseed meal 7½	Wheat shorts	Wheat shorts 50 ground corn 50
Pasture	Green wheat	Green wheat	Green wheat
Number of pigs	10	10	10
Days on feed	39	39	39
Average initial weight, lbs.	100.00	98.67	98.18
Average daily gain, lbs.	2.16	1.89	1.96
Average final weight, lbs.	184.26	172.46	174.60
Feed consumed per 100 lbs. gain	343.80	339.32	350.48
*Mineral consumed per 100 lbs. gain	.47	2.71	2.74
The calcium content in 100 lbs. of each feed mixture, lbs.	.59	.1	.06

*Minerals self-fed to all lots consisted, by weight, of oystershell flour 10 parts and salt 1 part.

Much experimental work has been conducted to determine the value of cottonseed meal as a supplement to and as a substitute for a portion of the carbohydrate concentrates for finishing pigs.

The Mississippi Experiment Station has conducted several studies, some of which resulted in high mortality, whereas, the results of other tests under similar conditions were highly satisfactory.

Four feeding trials were conducted to study the reduction or elimination of the toxic effect of cottonseed meal by the usage of ferrous sulphate. These tests were conducted in 1941, 1942, 1943, and 1944.

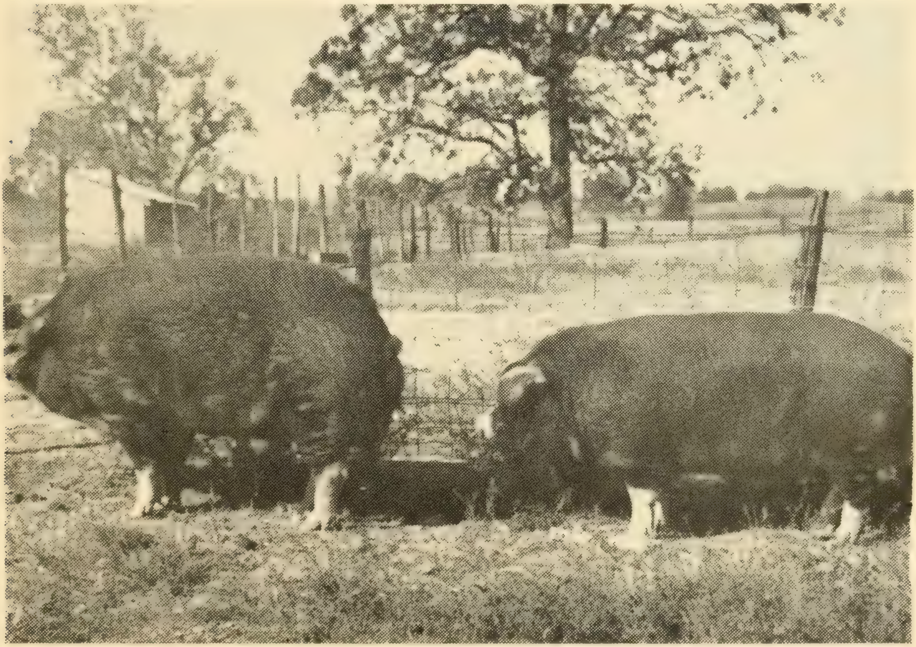

Figure 2. Types of boars commonly used, the large type and the medium.

Table 6 gives averaged weights, gains, and amount of feed required per 100 pounds of gain for the three lots of pigs included in this study.

The pigs made satisfactory gains and there were no serious results encountered from feeding large amounts of cottonseed meal. However, feeding trials conducted at this station under similar conditions resulted in a high mortality rate. Therefore, rations composed of 30 percent cottonseed meal cannot be recommended as a safe feeding practice.

Feed Crops Other Than Corn

Mississippi is a deficit state in corn production, because of which it is necessary almost every year to import from other states large quantities of livestock feeding stuffs. On account of transportation costs and added handling costs, corn-fed hogs can be produced more economically in areas of surplus corn production and least economically in areas where corn must be shipped in. This would seem to explain, at least in part, why pork production has not increased more rapidly in Mississippi during recent years.

Although corn is produced in profitable quantities in some areas and on some farms in other areas, the average State yield is too low to enable profitable pork production except where the mininum of corn and the most possible of other and more productive feed crops are used.

On the other side of the picture, a number of feed crops grown in Mississippi give yields high enough to enable profitable pork production. This field has not been sufficiently investigated to warrant a complete summary, but considerable amount of research has been done in Mississippi and other Southern States. Particularly important are soybeans; peanuts; soybeans or cowpeas or velvet beans interplanted with corn; barley, where conditions for growth are favorable; and perhaps sweetpotatoes.

Feeding Corn, Oats, and Barley to Pigs

During the past several years, added acreage in Mississippi has been given to the production of oats and barley. This is especially true in the Delta section and to a lesser but increasing extent in the Brown Loam and Prairie Areas. In many instances, small grains are being produced in commercial quantities, and their profitable use as livestock feeds on farms where produced, seems desirable.

Considerable work already has been conducted at other stations on the use of these feeds for fattening pigs, but this

Table 6. Feeding cottonseed meal to pigs: 1941, 1942, 1943, and 1944

Lot No.	1	2	3
Ration self-fed	Ground corn 85 tankage 7½ cottonseed meal 7½	Ground corn 70 cottonseed meal 30	Ground corn 70 cottonseed meal[1] 30
Pasture	Sudan grass	Sudan grass	Sudan grass
Number of pigs	10	10[2]	10[3]
Average days on feed	66.75	68.75	72.25
Average total pig days on feed	667.5	687.5	713.5
Average initial weight, lbs.	79.13	79.48	78.947
Average daily gain, lbs.	2.00	1.76	1.66
Average final weight, lbs.	213.35	200.36	199.17
Feed consumed per 100 lbs. gain	351.41	358.44	366.94
Mineral[4] consumed per 100 lbs. gain	.70	1.82	1.89

[1] Cottonseed meal treated with 3.4 pounds of ferrous sulphate per 100 pounds of cottonseed meal.

[2] One pig sick when test ended 1941.

[3] One pig disappeared 1943, after being on feed 23 days.

[4] Each lot self-fed mineral mixture composed of 5 pounds oystershell flour and 1 pound salt.

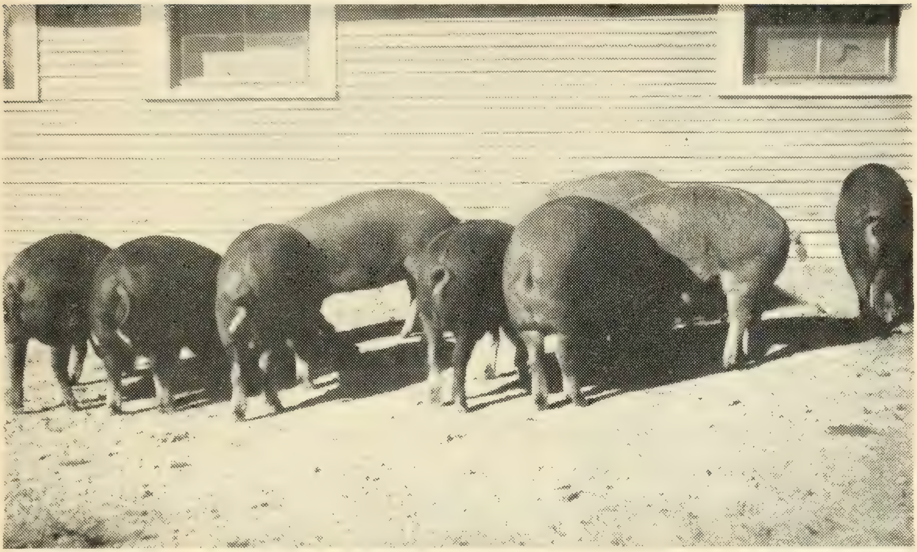

Figure 3. A group of thrifty pigs produced at the Mississippi Station.

study was in order to test the use of oats and barley grown under Mississippi conditions. Oats grown on the Mississippi Delta soil weigh more per bushel than the usual run of commercial oats grown in other sections of the country. Also, Mississippi oats, as well as Mississippi barley, differ slightly in chemical composition from the oats and barley produced in other parts of the country.

Therefore, three feeding trials were conducted to determine the value of Mississippi-grown oats and barley as a substitute for corn in fattening pigs. These tests were conducted in the spring of 1941, 1942, and 1943. A summary of the three feeding trials may be found in table 7.

It may be noted that the pigs fed ground corn made faster gains, followed by the barley fed lot, while those fed oats made the smallest daily gains.

While the gains made with barley were not as rapid as with corn, they were very economical. With ground corn and ground barley valued at the same price per pound, there was no significant difference in cost of gain between these two lots because less high-priced tankage was used in the barley lot.

The pigs fed oats required a longer period of time for fattening and required approximately 100 pounds more grain to produce 100 pounds of pork than did those fed corn or barley.

Feed Crops For Hogging-Down

Peanuts, soybeans, and sweetpotatoes are best harvested by the hogs. Where legumes are interplanted with corn it is perhaps more satisfactory to harvest and hand-feed a limited ration of corn while the pigs are hogging-off the interplanted soybeans, or cowpeas, or velvet beans. Small grains, such as barley, wheat, and oats, may be hogged-off, but usually are harvested and fed.

Where the necessary fencing is available or can be secured, "hogging-down" or "hogging-off" is a decided advantage because of the saving in labor.

Table 7. Value of corn, oats, and barley for fattening pigs: 1941, 1942, and 1943

Lot No.	1	2	3	4
Ration self-fed: Until pigs reached an average of 100 pounds each	Ground corn 85 tankage 15	Ground oats[1] 93 tankage 7	Ground oats[1] 93 tankage 7	Ground barley 89.9 tankage 10.1
From 100 pounds average liveweight until finished	Ground corn 90 tankage 10	Ground oats 97.7 tankage 2.3	Ground oats 97.7 tankage 2.3	Ground barley 95.3 tankage 4.7
Grazing	Green oats	Green oats	Green oats	Green oats
No. of pigs	10	10	10	10
Av. number days on feed	61.66	76.00	76.00	68.33
Av. initial weight, lbs.	82.64	82.40	82.28	82.15
Av. daily gain, lbs.	2.15	1.44	1.50	1.79
Av. final weight, lbs.	213.35	191.80	196.86	203.95
Feed consumed per 100 lbs. gain, lbs.	341.84	442.30	461.04	370.54
Mineral[2] consumed per 100 lbs. gain, lbs.	.67	1.55	1.39	.94

[1] Lot 2 was fed Mississippi-grown oats weighing 36-1/3 pounds per bushel.
Lot 3 was fed commercial oats weighing 33-1/3 pounds per bushel.

[2] Minerals self-fed to all lots consisted of 10 pounds of oystershell flour and 1 pound salt.

Table 8. Soybeans grown with corn, the corn gathered and the beans grazed; also beans grazed and corn hand-fed

Lot No.	First year results		Second year results	
	1	2	3	4
	Soybeans grazed alone	Soybeans grazed plus 2½ percent corn	Soybeans grazed alone	Soybeans grazed plus 2½ percent corn
Length of trial, days	56	56	42	42
No. of pigs used	12	12	12	12
Av. initial weight, lbs.	143	141	119	120
Av. daily gain, lbs.	1.12	1.62	.86	1.58
Av. final weight, lbs.	206	232	155	250
Corn fed per cwt. of gain, lbs.	-	287	...	--

These results are taken from Mississippi Experiment Station Bulletin 283.

Grazing and Feeding Trials With Corn and Soybeans

Realizing that the use of soybeans was rapidly increasing in Mississippi, both as a soil improver and for the production of pork, experimental work was conducted at the Mississippi Experiment Station to try to determine the most desirable variety and economical way of utilizing the beans for the production of pork. Most of the trials conducted were with the Mammoth Yellow and Laredo beans. Table 8 gives a summary of the results of some work conducted 2 different years. The soybeans were grown in the row with corn, the corn gathered, and the beans grazed alone; in another phase of the experiment the beans were grazed and one-half percent corn was hand-fed daily. That is, the amount fed per day was 2½ percent of the liveweight of the hogs in that lot.

Assuming that the equivalent of 500 pounds of corn is required to produce 100 pounds of gain, it will be noted in this table that when the pigs were grazing on beans with 2½ percent ration of corn hand-fed daily, the beans replaced 213 to 250 pounds of corn per hundred weight of gain.

The bean yield per acre was noted to be much smaller the second year. The

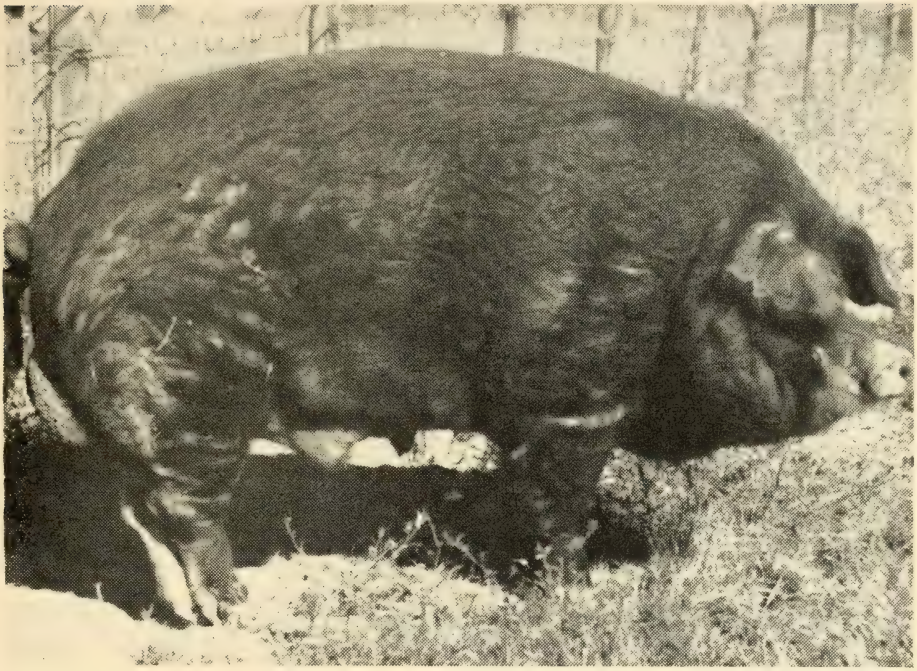

Figure 4. A Poland China boar of the Mississippi Agricultural Experiment Station.

smaller daily gains in lot 3 as compared to the daily gains in lot 1 may, probably, be attributed to the scarcity of beans.

Hogging-Down Corn and Soybeans

Pigs of varying initial liveweights were used in hogging-down corn and Mammoth Yellow beans as compared to hogging-down corn and Laredo soybeans. The results of these trials may be seen in table 9.

The corn and beans were grown together in the same row as usual, and the crop was mature when the pigs were turned into the fields. The hogs did not start breaking down the corn in the Mammoth Yellow bean field for several days and were content to consume beans in preference to corn. However, during this time in the Laredo soybean field the pigs had broken down and consumed a considerable amount of corn.

Each lot of pigs had free access to a mineral mixture composed of 5 pounds

Table 9. Hogging-down corn and soybeans

Lot number	1	2	3	4	5	6
Variety of beans grazed	Mammoth Yellow	Laredo	Mammoth Yellow	Laredo	Mammoth Yellow	Laredo
Length of trial days	42	42	56	56	59	59
Number of pigs used	14	14	15	15	12	12
Average initial weight, lbs.	126.9	127	98.3	98	101.75	96.41
Average daily gain, lbs.	2.47	2.23	1.71	1.58	1.77	1.34
Average final weight, lbs.	230.85	220.92	194.2	186.8	206.75	175.60

These results are taken from Mississippi Experiment Station Bulletin 283.

Each lot of pigs had free access to a mineral mixture composed of 5 pounds each of acid phosphate and air slaked lime, plus 1 pound of salt.

each of acid phosphate and air slaked lime plus 1 pound of salt. Lots 1 and 2, and also lots 3 and 4, are comparable in every respect except for hogging-down different varieties of soybeans with corn. In each instance, higher daily gains were made on the Mammoth Yellow beans.

It will also be noted that the pigs in lot 5, grazing on Mammoth Yellow beans and corn, made faster daily gains than the pigs in lot 6 grazing on Laredo beans and corn.

Self-Feeding and Hogging-Down Corn and Soybeans

This work was conducted in order to compare the palatability of the different varieties of soybeans, and also to get a relative comparison of gains when hogging-down versus self-feeding in dry lot. The results of this work are given in table 10.

It will be noted that it required from 340 to 380 pounds of corn and beans combined when self-fed free-choice in dry lot, to produce 100 pounds of pork on foot. The proportion of soybeans consumed free-choice to that of corn ranged from approximately one-third to one-fourth. The choice of consumption varied with the different variety of beans.

With the known yield of an acre of corn and beans, it would be possible to apply the above results and probably make a fair estimate of the expected pork to be produced when hogging-down the acre of corn and soybeans.

By referring to lots 2 and 6 it will be noted that the pigs hogging-down corn and Mammoth Yellow beans gained more rapidly than the pigs being self-fed the same variety of beans and corn in dry lot.

Methods of Handling Corn and Soybeans for Pork Production

Among the methods of handling the soybean crop that have been tried by this Station have been the following:

Table 10. Self-feeding shelled corn and whole soybeans, free choice, and hogging-down corn and soybeans

Lot number	1	2	3	4	5	6	7
Method of feeding	Self-fed free choice Dry lot	Self-fed free choice Dry lot	Self-fed free choice Dry lot	Self-fed free choice Dry lot	Self-fed free choice Dry lot	Hogging-down	Hogging-down
Ration	Corn and tankage	Corn and Mammoth Yellow beans	Corn and Laredo beans	Corn and Manchu beans	Corn; Laredo and Mammoth Yellow beans	Corn and Mammoth Yellow beans	Corn and Laredo beans
Length of trial, days	59	59	59	59	59	59	59
Number of pigs	8	8	8	7	7	12	12
Av. initial wt., lbs.	101.87	101.25	101.75	101.14	102.57	101.75	96.41
Av. daily gains, lbs.	1.96	1.45	1.43	1.25	1.27	1.77	1.34
Av. final wt., lbs.	217.62	187.25	186.37	175.00	177.57	206.75	175.60
Feed consumed per 100 lbs. gain:							
Corn, lbs.	311.77	229.65	271.93	315.08	277.33	----	----
Tankage, lbs.	37.68	----	----	----	----	----	----
Mammoth Yellow beans, lbs.	----	112.50	----	----	104.57	----	----
Laredo beans, lbs.	----	----	87.00	----	0.0*	----	----
Manchu beans, lbs.	----	----	----	52.22	----	----	----
Proportion of corn to soybeans		2.04:1	3.12:1	6.03:1	2.74:1		----

*Only one pound of Laredo soybeans was consumed during feeding test. All lots had free access to mineral mixture composed of 5 pounds each of acid phosphate and air slaked lime, plus 1 pound of salt. These results are taken from Mississippi Experiment Station Bulletin 283.

1. Growing and grazing soybeans alone. Results shown in lot 1.
2. Growing soybeans with corn, the corn being gathered and the beans grazed. Results shown in lot 2.
3. Growing soybeans with corn, the corn being gathered and the beans grazed and supplemented with a small amount of corn hand-fed. Results shown in lot 3.
4. Growing soybeans with corn, the corn being gathered and the beans grazed and supplemented with a medium amount of corn hand-fed. Results shown in lot 4.
5. Growing and grazing soybeans and corn together. Results shown in lot 5.

The results shown in table 11 indicate that personal choice of the grower may well determine whether soybeans and corn are to be grown alone or in combination, and whether the corn and soybeans, or only the soybeans, are to be hogged-down. Good yields of pork per acre were made in all cases.

Grazing Trials With Peanuts

Feeding trials were conducted 3 different years allowing pigs to consume peanuts in the field. The stand during each of the latter 2 years was probably less than 50 percent of normal which accounts for the small amount of pork produced per acre in these trials. Therefore, the results of the first year's work are probably more nearly representative of what may be expected in this section of the State with an ordinarily good crop of peanuts. The yield of peanuts the first year was estimated at 45 bushels per acre. The results of the 3 years' work are given in table 12.

Table 11. Methods of utilizing corn and soybeans in pork production

	Lot 1	Lot 2	Lot 3	Lot 4	Lot 5
	Av. 3 yrs.	Av. 4 yrs.	Av. 3 yrs.	Av. 5 yrs.	Av. 5 yrs.
Date of starting	October	September	September	October	September
Area grazed, acres	1.44	1.96	1.94	1.42	2.45
Number of hogs used	7.3	10.0	10.3	9.8	22.4
Length of grazing period, days	39.0	42.4	42.4	45.3	42.3
Average initial weight, lbs.	116.3	102.5	110.0	109.5	99.2
Average final weight, lbs.	168.0	148.4	168.7	176.4	170.5
Average gain per hog, lbs.	51.6	46.0	58.7	66.3	71.2
Average daily gain per hog, lbs.	1.07	1.07	1.37	1.47	1.65
Corn fed per hog, lbs.	---	----	62.8	135.48	----
Av. amt. of corn fed per hog per day, lbs.	----	---	1.45	3.05	---
Corn fed per cwt. of gain, lbs.	----	----	108.35	206.42	----
Pork produced per acre	260.91	219.95	313.28	435.32	461.6

Source: Mississippi Agricultural Experiment Station Circular 49.

Table 12. Grazing trials with peanuts

	First year work	Second year work	Third year work
Lot number	1	2	3
Ration	Peanuts	Peanuts	Peanuts
Number of hogs used	12	12	12
Length of grazing period, days	36.0	39.5	38.5
Average initial weight, lbs.	115.75	96.7	126.3
Average daily gain, lbs.	1.85	1.88	1.38
Average final weight, lbs.	182.5	170.8	179.4
Pork produced per acre, lbs.	347.8	187.16	134.32

Source: Mississippi Agricultural Experiment Station Bulletin 218.

BULLETIN 411 DECEMBER 1944

Cotton Varieties
in the
Hill Section of Mississippi
1944

By

J. FRED O'KELLY

Head, Agronomy Department

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
STATE COLLEGE MISSISSIPPI

COTTON VARIETIES IN THE HILL SECTION OF MISSISSIPPI

By J. FRED O'KELLY

E. B. Ferris, H. A. York, and T. E. Ashley collected the field data for these tests at Holly Springs, Raymond, and Poplarville, respectively.

Aside from a late start the 1944 season was favorable for cotton production in practically all areas of the State. Frequent rains at the normal planting time delayed planting 2 to 3 weeks. After the crop was planted, germination was slow in some cases due to insufficient rainfall. The months of June and July were sufficiently dry and hot for better than usual boll weevil control and for a limited labor supply to control weeds.

Lint cotton prices used in computing acre values are averages for 10 weeks as reported for the Memphis, Tennessee, market, beginning early in September. Seed were valued at $54.10 a ton. Staple length determinations were made by commercial cotton classers.

The late spring and summer drouth was probably more severe at Holly Springs than in most other areas. The acre yields and staple lengths, especially for the hill test, show that there was not enough moisture even for cotton.

Both the hill and valley tests were planted on soil where a light growth of a winter legume had been turned and 400 pounds to the acre of a 6-8-4 fertilizer had

Table 1. Cotton varieties: average results, State College, 1940-1944

Variety	Pounds lint per acre						Average total[1] value	Length inches	Lint per-centage	Bolls per lb. lint
	1940	1941	1942	1943	1944	Av.				
Deltapine 14	244.3	209.8	621.0	585.9	607.4	453.7	$105.72	1 1/16	40.4	201
Hi-Bred	291.2	251.3	574.6	612.3	436.3	433.1	86.84	7/8	42.5	158
Cleveland 54	277.0	221.9	599.8	494.2	571.4	432.9	95.26	15/16	37.1	207
Coker 100-7[2]	302.1	269.8	551.2	423.0	562.4	421.7	104.32	1 1/8	38.1	204
Stoneville 2B	301.1	205.1	571.7	511.1	509.6	419.7	102.24	1 3/32	35.3	199
Miller	212.5	210.5	584.4	541.5	548.2	419.4	95.71	31/32	37.2	186
Bobshaw 1	285.2	224.1	527.3	480.4	488.7	401.1	91.69	1 1/32	36.9	229
Delfos 531C	307.3	173.7	515.3	486.5	465.7	389.7	105.25	1 5/32	35.3	234
Delfos 651[3]	265.5	163.9	520.5	481.6	480.2	382.3	99.81	1 1/8	34.4	232

[1] Based on middling grade. [2] Coker 100-4, 1940; 100-5, 1941 and 1942. [3] Delfos 6, 1940; 3506, 1941.

Table 2. Cotton varieties: State College, 1944

Total acre value, expressed in three grades

Variety	Pounds lint per acre	Middling	Strict low middling	Low middling	Length inches	Lint percent-age	Bolls per lb. lint
Deltapine 14	607.4	$157.62	$150.33	$134.54	1 1/32	40.6	198
Delfos 9169	588.1	166.94	156.06	136.95	1 3/32	36.8	194
Cleveland 54	571.4	147.14	140.00	127.43	15/16	38.3	195
Coker 100-7	562.4	152.44	144.57	127.70	1 1/16	38.0	203
Miller	548.2	141.77	134.92	122.86	15/16	37.7	190
Empire	539.0	141.02	134.01	120.81	1	38.5	177
Coker 100W-3	537.0	141.49	134.51	121.36	1	37.5	193
Stoneville 5A	525.5	135.84	130.06	117.19	31/32	38.3	212
Stoneville 2B	509.6	136.15	130.04	116.79	1 1/32	36.4	193
Bobshaw 1	488.7	129.44	123.09	111.11	1	36.8	211
Delfos 651	480.2	133.20	126.47	112.07	1 1/16	34.9	228
Delfos 9431	467.0	134.43	125.79	110.62	1 3/32	34.9	238
Delfos 531C	465.7	134.37	125.76	110.62	1 3/32	34.6	232
Boboak	449.4	130.18	121.87	107.26	1 3/32	34.1	240
Hi-Bred	436.3	98.38	94.46	85.73	13/16	42.2	155
Bobdel	414.3	115.48	109.68	97.25	1 1/16	34.3	225

Table 3. Cotton varieties: average results, Holly Springs, hill soil, 1940-1944

Variety	Pounds lint per acre						Average total[1] value	Length inches	Lint per-centage	Bolls per lb. lint
	1940	1941	1942	1943	1944	Av.				
Hi-Bred	586.9	568.2	735.2	368.6	413.3	534.4	$ 99.33	27/32	42.9	172
Stoneville 2B	609.0	548.3	737.5	320.1	437.1	530.4	113.39	1 1/16	36.0	200
Bobshaw 1	520.2	569.7	789.7	327.8	362.2	513.9	107.48	1	37.1	216
Deltapine 14	445.8	647.6	669.6	348.6	408.6	504.0	105.98	1 1/32	40.1	208
Miller	461.2	580.2	652.9	373.2	364.5	486.4	100.75	31/32	38.0	179
Cleveland 54	471.2	564.2	621.6	313.0	361.6	466.3	94.24	29/32	37.1	213
Delfos 651[2]	466.9	526.3	665.1	298.4	342.6	459.9	104.95	1 3/32	35.7	238
Delfos 531C	509.9	525.2	615.0	293.5	333.7	455.5	108.75	1 1/8	35.3	240
Coker 100-7[3]	499.0	495.4	621.2	311.7	347.4	454.9	100.08	1 3/32	38.5	213

[1] Based on middling grade.

[2] Delfos 6, 1940; Delfos 3506, 1941.

[3] Coker 100-4, 1940; Coker 100-5, 1941 and 1942.

Table 4. Cotton varieties: Holly Springs, hill soil, 1944

Total acre value, expressed in these grades

Variety	Pounds lint per acre	Middling	Strict low middling	Low middling	Length inches	Lint percent-age	Bolls per lb. lint
Stoneville 2B	437.1	$115.91	$110.67	$ 99.30	1 1/32	37.4	205
Hi-Bred	413.3	91.88	88.16	79.89	13/16	44.4	166
Delfos 9169	412.2	112.28	106.51	94.14	1 1/16	37.3	198
Deltapine 14	408.6	106.10	101.20	90.58	1 1/32	40.5	201
Coker 100W-3	407.7	106.89	101.59	91.60	1	38.2	194
Empire	385.2	98.81	94.57	85.13	31/32	39.4	180
Miller	364.5	93.01	88.46	80.44	15/16	39.6	178
Bobshaw 1	362.2	95.98	91.64	82.22	1 1/32	37.5	203
Cleveland 54	361.6	90.89	87.46	79.32	29/32	38.1	197
Coker 100-7	347.4	94.23	89.37	78.94	1 1/16	37.9	229
Stoneville 5A	347.1	90.69	86.18	77.68	1	38.7	222
Delfos 9431	345.8	95.17	90.33	79.95	1 1/16	35.9	245
Delfos 651	342.6	94.00	89.20	78.93	1 1/16	36.3	246
Delfos 531C	333.7	95.48	89.31	78.47	1 3/32	35.7	250
Boboak	332.1	92.05	87.40	77.43	1 1/16	35.0	242
Bobdel	304.0	82.26	78.61	70.71	1 1/32	34.8	235

Table 5. Cotton varieties: average results, Holly Springs, valley soil, 1940-1944[1]

Variety	Pounds lint per acre					Average total[2] value	Length inches	Lint percent-age	Bolls per lb. lint
	1940	1942	1943	1944	Av.				
Bobshaw 1	343.4	705.9	561.0	641.0	562.8	$124.44	1 1/16	34.6	216
Stoneville 2B	376.7	604.9	641.2	537.6	540.1	136.80	1 1/8	34.3	191
Cleveland 54	265.1	684.6	579.8	626.2	538.9	124.45	31/32	34.3	215
Hi-Bred	247.1	705.9	635.5	565.5	538.5	115.09	29/32	39.8	168
Miller	204.7	733.5	589.4	622.0	537.4	127.03	1	35.3	186
Deltapine 14	193.9	646.6	652.5	588.3	520.3	128.54	1 3/32	37.1	231
Coker 100-7[3]	359.9	579.6	570.4	551.6	515.4	140.58	1 5/32	35.1	207
Delfos 531C	291.0	537.6	536.9	558.2	480.9	144.47	1 3/16	32.6	246
Delfos 651[4]	272.6	566.9	527.9	540.8	477.0	139.64	1 3/16	32.5	244

[1] Averages are for 4 years; no data were obtained in 1941.

[2] Based on middling grade.

[3] Coker 100-4, 1940; Coker 100-5, 1942.

[4] Delfos 6, 1940.

been applied. Planting was done about the middle of May. Normal cultural practices were followed thereafter.

The test at State College was planted May 11. The soil had been previously fertilized with about 400 pounds of 6-8-4 to the acre. No winter legume was used. The soil was a modified Houston clay sometimes classed as Beli.

The soil for the Raymond tests produced a good crop of vetch. After this was turned, fertilizer was applied at the rate of 250 pounds 6-8-8 to the acre. Planting was done on May 9.

The high yields on the valley test can be attributed to the fact that this piece of soil retains moisture quite well. Adequate soil fertility and moisture combined with a season dry enough for insect control provide an environment favorable to high cotton yields.

The soil for the Poplarville test was fertilized at the rate of 600 pounds 6-8-4 to the acre and was planted April 25. Soil moisture deficiencies were not as serious here as in other areas but the season was dry enough for fair boll weevil control. The yields were excellent for this area.

In planning a long-time cotton production program in the State, too much weight should not be given to the very

Table 6. Cotton varieties: Holly Springs, valley soil, 1944

Total acre value, expressed in three grades

Variety	Pounds lint per acre	Middling	Strict low middling	Low middling	Length inches	Lint percentage	Bolls per lb. lint
Stoneville 5A	641.0	$169.38	$161.69	$145.02	1 1/32	37.9	210
Delfos 9169	626.9	171.38	162.60	143.79	1 1/16	36.8	193
Cleveland 54	626.2	161.59	153.76	139.98	15/16	38.0	192
Miller	622.0	162.29	154.20	138.96	1	38.9	169
Coker 100W-3	596.8	157.37	149.61	134.99	1	37.4	189
Deltapine 14	588.3	152.96	145.90	130.60	1 1/32	40.3	185
Hi-Bred	565.5	134.83	129.74	119.56	7/8	43.1	152
Delfos 531C	558.2	172.44	157.37	134.77	1 1/8	35.1	232
Empire	557.6	145.59	138.34	124.68	1	38.8	166
Coker 100-7	551.6	155.19	144.99	127.06	1 3/32	38.1	189
Delfos 651	540.8	155.32	145.32	127.74	1 3/32	35.2	224
Delfos 9431	539.5	155.42	145.44	127.91	1 3/32	34.8	226
Stoneville 2B	537.6	146.75	139.22	123.09	1 1/16	37.0	178
Bobshaw 1	511.1	136.04	129.91	116.62	1 1/32	36.9	193
Boboak	497.8	143.97	134.76	118.58	1 3/32	34.3	232
Bobdel	458.4	124.55	119.05	107.13	1 1/32	34.3	227

Table 7. Cotton varieties: average results, Raymond, hill soil, 1940-1944

Variety	Pounds lint per acre						Average total[1] value	Length inches	Lint percentage	Bolls per lb lint
	1940	1941	1942	1943	1944	Av.				
Hi-Bred	583.2	479.1	710.4	633.8	630.2	607.3	$140.27	13/16	41.7	173
Stoneville 2B	578.0	541.8	758.0	550.7	549.0	595.5	144.88	1 1/16	35.9	205
Deltapine 14	551.8	494.0	761.9	567.9	600.7	595.3	151.64	1 1/32	39.9	221
Bobshaw 1	530.0	570.8	718.0	607.1	533.9	592.0	143.88	1	36.7	227
Cleveland 54	535.0	511.1	713.2	590.4	555.7	581.1	135.87	29/32	36.4	218
Coker 100-7[2]	512.7	487.7	768.8	563.4	541.5	574.8	141.71	1 3/32	38.2	212
Miller	548.3	522.5	693.7	550.6	548.1	572.6	137.07	15/16	37.1	190
Delfos 531C	474.3	454.6	702.6	483.0	488.9	520.7	133.85	1 1/8	35.1	244
Delfos 651[3]	484.9	416.2	683.3	498.4	487.6	514.1	130.17	1 3/32	34.7	242

[1] Based on middling grade.

[2] Coker 100-4, 1940; Coker 100-5, 1941 and 1942.

[3] Delfos 6, 1940; Delfos 3506, 1941.

Table 8. Cotton varieties: Raymond, hill soil, 1944

Total acre value, expressed in three grades

Variety	Pounds lint per acre	Middling	Strict low middling	Low middling	Length inches	Lint percentage	Bolls per lb. lint
Hi-Bred	630.2	$140.27	$134.60	$122.00	13/16	44.2	154
Coker 100W-3	607.5	158.66	151.98	138.10	31/32	36.9	200
Deltapine 14	600.7	151.64	145.03	130.32	31/32	41.9	189
Cleveland 54	555.7	135.87	130.86	120.86	7/8	38.3	199
Bobshaw 1	553.9	143.88	136.96	124.78	15/16	37.1	214
Stoneville 2B	549.0	144.88	137.74	124.29	1	37.3	196
Miller	548.1	137.07	131.86	119.53	29/32	38.8	182
Stoneville 5A	543.9	140.39	134.41	122.08	31/32	38.5	220
Coker 100-7	541.5	141.71	135.21	121.13	1 1/32	39.3	208
Empire	538.5	138.91	132.98	119.79	31/32	38.6	179
Delfos 9169	508.9	134.57	128.46	115.23	1 1/32	37.8	193
Delfos 9431	491.2	131.43	125.54	112.77	1 1/32	36.2	232
Delfos 531C	488.9	133.85	127.01	112.34	1 1/16	36.6	237
Delfos 651	487.6	130.17	124.32	111.64	1 1/32	36.5	224
Bobdel	454.3	120.16	115.17	104.04	31/32	35.3	232
Boboak	451.0	121.87	116.01	104.96	1	34.3	244

Table 9. Cotton varieties: average results, Raymond, valley soil, 1940-1944

Variety	Pounds lint per acre						Average total[1] value	Length inches	Lint percentage	Bolls per lb lint
	1940	1941	1942	1943	1944	Av.				
Bobshaw 1	527.6	403.4	790.6	826.3	1022.5	714.1	$169.04	1 1/16	35.0	206
Deltapine 14	527.2	396.1	731.1	921.1	985.3	712.2	176.35	1 3/32	38.7	199
Cleveland 54	463.5	385.3	679.3	747.4	1067.7	668.6	152.47	31/32	34.2	209
Coker 100-7[2]	559.3	371.1	632.4	782.3	990.8	667.2	181.98	1 5/32	35.2	195
Hi-Bred	490.1	350.6	561.0	923.4	1002.9	665.6	138.00	7/8	39.3	164
Stoneville 2B	529.6	345.9	651.2	786.4	1007.0	664.0	171.63	1 3/32	33.7	193
Miller	485.7	369.1	650.5	727.3	1039.1	654.3	148.37	1	35.3	177
Delfos 531C	475.6	321.0	626.8	671.0	915.3	601.9	175.55	1 3/16	32.7	223
Delfos 651[3]	434.9	274.8	658.2	658.8	916.0	588.5	167.10	1 5/32	32.9	233

[1] Based on middling grade.

[2] Coker 100-4, 1940; Coker 100-5, 1941 and 1942.

[3] Delfos 6, 1940; Delfos 3506, 1941.

Table 10. Cotton varieties: Raymond, valley soil, 1944

Total acre value, expressed in three grades

Variety	Pounds lint per acre	Middling	Strict low middling	Low middling	Length inches	Lint percentage	Bolls per lb lint
Cleveland 54	1067.7	$274.34	$260.99	$237.50	15/16	38.6	171
Empire	1039.3	271.17	257.66	232.19	1	38.9	156
Miller	1039.1	265.70	252.71	229.85	15/16	39.3	150
Delfos 9169	1032.0	280.70	266.26	235.30	1 1/16	37.5	164
Bobshaw 1	1022.5	268.84	255.54	230.49	1	37.8	181
Stoneville 2B	1007.0	267.24	255.16	228.97	1 1/32	37.3	163
Hi-Bred	1002.9	236.19	227.17	209.11	7/8	43.9	135
Coker 100W-3	994.0	262.28	250.35	224.51	1 1/32	38.1	178
Coker 100-7	990.8	266.58	252.71	222.99	1 1/16	39.1	170
Deltapine 14	985.3	254.11	242.28	216.66	1 1/32	41.6	166
Stoneville 5A	957.8	250.94	238.49	215.02	1	38.3	182
Delfos 9431	925.5	263.66	246.53	216.46	1 3/32	36.3	194
Delfos 651	916.0	261.14	244.19	214.42	1 3/32	36.2	199
Delfos 531C	915.3	281.19	256.48	219.41	1 1/8	35.9	213
Boboak	911.0	262.44	245.59	215.98	1 3/32	34.8	189
Bobdel	824.2	228.78	217.24	192.52	1 1/16	34.8	193

high yields of 1944. Weather conditions are not always so favorable. The 5-year averages are a better guide to cotton production in general and to the choice of a variety in particular.

It may be well to point out that among new strains tried, Delfos 9169 has made an excellent record for 2 years. If it compares as favorably with other varieties in seasons of too much rainfall, this variety will have much promise. It should be noted that Coker 100-W has performed good to well in nearly all tests in recent years, and on soil with moderate wilt infestation it is usually a top producer.

Table 11. Cotton varieties: average results, Poplarville, 1940-1944

Variety	Pounds lint per acre						Average total[1] value	Length inches	Lint per-centage	Bolls per lb. lint
	1940	1941	1942	1943	1944	Av.				
Hi-Bred	524.2	511.6	278.0	345.3	610.5	453.9	$84.94	27/32	43.2	180
Cleveland 54	498.9	489.7	290.0	363.8	513.5	431.2	86.58	29/32	38.2	221
Miller	444.1	437.6	341.2	229.1	540.0	398.4	81.56	15/16	38.9	192
Stoneville 2B	533.9	469.2	270.3	261.3	439.7	394.9	82.97	1 1/16	36.7	223
Bobshaw 1	406.7	457.5	349.7	280.8	418.1	382.6	80.09	1	37.5	232
Deltapine 14	414.2	431.5	259.7	252.0	540.5	379.6	78.75	1 1/32	41.9	218
Coker 100-7[2]	398.9	486.8	274.6	204.1	455.6	364.0	79.87	1 3/32	38.5	212
Delfos 651[3]	367.0	369.1	154.7	268.7	456.0	323.1	75.05	1 1/8	35.7	244
Delfos 531C	363.3	382.8	178.5	165.1	482.3	314.4	74.45	1 1/8	36.0	260

[1] Based on middling grade.

[2] Coker 100-4, 1940; Coker 100-5, 1941 and 1942.

[3] Delfos 6, 1940; Delfos 3505, 1941.

Table 12. Cotton varieties: Poplarville, 1944

Total acre value, expressed in three grades

Variety	Pounds lint per acre	Middling	Strict low middling	Low middling	Length inches	Lint percent-age	Bolls per lb lint
Hi-Bred	610.5	$140.64	$134.53	$122.93	27/32	43.3	141
Deltapine 14	540.5	137.53	130.50	117.26	1	42.9	180
Miller	540.0	137.16	130.41	118.53	15/16	40.3	160
Delfos 9169	534.5	143.62	136.04	120.00	1 1/16	39.3	183
Cleveland 54	513.5	131.40	124.98	113.68	15/16	39.2	179
Coker 100W-3	486.8	125.13	119.78	107.85	31/32	39.1	172
Stoneville 5A	486.4	125.74	120.39	108.47	31/32	38.3	183
Delfos 531C	482.3	131.56	124.81	110.34	1 1/16	37.1	218
Empire	482.2	126.55	120.28	108.47	1	39.2	158
Bobdel	477.3	127.63	121.90	109.49	1 1/32	36.3	201
Delfos 651	456.0	123.60	117.22	103.54	1 1/16	38.0	197
Coker 100-7	455.6	117.62	111.70	100.53	1	40.5	191
Boboak	448.3	120.82	115.44	103.78	1 1/32	35.3	223
Stoneville 2B	439.7	115.11	109.40	98.63	1	38.4	176
Delfos 9431	433.8	118.08	112.01	99.00	1 1/16	37.4	217
Bobshaw 1	418.1	111.25	105.82	95.58	1	36.2	178

Table 13. Cotton varieties, six locations, 1944

Variety	Pounds lint per acre							Averages		
	Holly Springs		State College	Raymond		Poplar-ville	Aver-age	Staple length inches	Lint percent-age	Bolls per lb. lint
	Hill	Valley		Hill	Valley					
Deltapine 14	409	588	607	601	985	540	622	1	41.3	186
Delfos 9169	412	627	588	509	1032	534	617	1 1/16	37.6	187
Cleveland 54	362	626	571	556	1068	513	616	29/32	38.4	189
Miller	364	622	548	548	1039	540	610	15/16	39.1	171
Hi-Bred	413	565	436	630	1003	610	609	27/32	43.5	150
Coker 100W-3	408	597	537	607	994	487	605	1	37.9	188
Empire	385	558	539	539	1039	482	590	1	38.9	169
Stoneville 5A	347	641	525	544	958	486	583	1	38.3	205
Stoneville 2B	437	538	510	549	1007	440	580	1 1/32	37.3	185
Coker 100-7	347	552	562	541	991	456	575	1 1/16	38.8	198
Bobshaw 1	362	511	489	554	1022	418	559	1	37.0	197
Delfos 531C	334	558	466	489	915	482	541	1 3/32	35.8	230
Delfos 651	343	541	480	488	916	456	537	1 1/16	36.2	220
Delfos 9431	346	539	467	491	925	434	534	1 1/16	35.9	225
Boboak	332	498	449	451	911	448	515	1 1/16	34.6	228
Bobdel	304	458	414	454	824	477	488	1 1/32	35.0	219

Seed Sources, 1944

Bobdel—Bobshaw Seed Co., Heathman, Mississippi.

Boboak—Bobshaw Seed Co., Heathman, Mississippi.

Bobshaw 1—Bobshaw Seed Co., Heathman, Mississippi.

Cleveland 54—Mississippi Experiment Station, State College, Mississippi.

Coker 100-7 and 100W-3—Coker Pedigreed Seed Co., Hartsville, South Carolina.

Delfos 531C and 9169—Stoneville Pedigreed Seed Co., Stoneville, Mississippi.

Delfos 651 and 9431—Delta Experiment Station, Stoneville, Mississippi.

Deltapine 14—Delta and Pine Land Co., Scott, Mississippi.

Empire—Georgia Experiment Station, Experiment, Georgia.

Hi-Bred—B. F. Summerour, Norcross, Georgia.

Miller—Mississippi Experiment Station, State College, Mississippi.

Stoneville 2B and 5A—Stoneville Pedigreed Seed Co., Stoneville, Mississippi.

The seed sources given are, in all cases, the originator of the variety or strain. If farmers are unable to obtain seed from the originator they may be able to purchase through an authorized dealer. Seed of many of the varieties were certified in 1944. A list of certified seed and the producers may be had by writing the Secretary Seed Improvement Association, State College, Mississippi.

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Beef Calf Production in Mississippi

A good pasture is the foundation of livestock production. Above is a view of the Experiment Station's East pasture, established about 50 years ago.

MISSISSIPPI STATE COLLEGE
AGRICULTURAL EXPERIMENT STATION
CLARENCE DORMAN, Director
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Beef calf production under conditions of minimum investment in pastures and breeding herds, has been conducted a minimum of 3 years at four Mississippi locations.

Native South Mississippi cows costing from $25.00 to $45.00 each, and purebred beef type bulls, were used. Various pasture establishment practices were used at the several locations, but all pastures were mowed at least once each year. No housing was provided. The principal winter feed was hay, stacked in the pastures; however, various feed resources were utilized at all locations. With the exception of a limited number of heifers saved for herd improvement, all increase was marketed as milk-fat calves.

In general, pastures sufficient for beef calf production were established or maintained at all locations, and further improvement is under way; feed for wintering was economically produced at all locations; and herds made up of native South Mississippi cows and beef type bulls produced calves at all locations which sold at or near top prices on the four markets utilized.

At the Natchez Branch Station, 8 heifer calves were kept for herd improvement; 9 calves marketed, averaging 361.1 pounds liveweight, sold at an average of 12.77 cents per pound or $46.09 per head.

At the Holly Springs Branch Station, no heifer calves were kept for herd improvement; 23 calves marketed, averaging 355.6 pounds liveweight, sold at an average of 13.71 cents per pound or $48.76 per head.

At the Oktibbeha-Winston Land Use Experimental Area, 22 heifer calves were kept for herd improvement; 155 calves marketed, averaging 357 pounds liveweight, sold at an average of 12 cents per pound or $42.84 per head.

At the Central Station, State College, 6 heifer calves were kept for herd improvement; 6 calves marketed, averaging 500 pounds liveweight, sold at an average of 13 cents per pound or $65.00 per head.

The average price received per head for calves marketed, though information of value, is an inexact basis for comparison of production at the several locations, because the calves were marketed as conditions appeared to warrant at various times, ages, and weights. It is hoped that these investigations may be continued until pastures approach maximum efficiency at all locations and until additional information can be secured on various beef herd management practices under Mississippi conditions.

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Beef Calf Production in Mississippi

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The increased production of beef cattle has been recognized as one of the great agricultural possibilities of Mississippi.

Much of the land area of the State is unsuitable for profitable row-crop production—some of it having slopes so steep that cultivation invites erosion, some of it already badly eroded, some of it in lowlands too subject to overflow for safe crop production, and some of it so lacking in natural fertility as to require the annual application of very large amounts of commercial fertilizer. There is a definite need for the profitable utilization of such land on every farm as may not be suitable for profitable row-crop culture, and pastures and livestock seem to answer the problem on numerous Mississippi farms.

In addition to the need for a means of economically utilizing non-productive or unprofitable acres, the need for cash income in addition to that from cotton is pressing. The increased production of livestock seems to offer an answer to that and other problems on numerous Mississippi farms—more livestock to serve as a cash market for grain and forage produced, to supply fertility to the land, to profitably utilize pasturage, and to add materially to the family food supply and to the cash income of the farm.

This report is concerned with a particularized phase of livestock production: the production of beef calves to be sold at weaning. There are numerous other phases of livestock production, including other phases of beef production, dairying, poultry production, sheep and wool production, and swine production. The choice between them is an individual matter for each farm, and the determination of which one or which combination of livestock enterprises may be best for any particular farm, must be made by each farmer on the basis of such factors as labor supply, capital, land and feed available for the livestock enterprise, markets, and the farmer's personal preference and liking. The purpose of this report is not so much to "sell" beef production above other livestock enterprises, as to indicate the financial possibilities of beef production on areas which are representative of large numbers of Mississippi farms.

Fluctuating Livestock Production

Livestock production has steadily and considerably increased in Mississippi during recent years. As late as 1930, the number of cattle on Mississippi farms was only 841,067; at the beginning of 1944 there were 1,488,000. This represents an increase of 77 percent in cattle population. Due in large part to the AAA program, there has been an increase in the combined acreage of grain and roughages. A portion of the consequent increase in the production of grain and roughages has been used to supply deficiencies which have long existed on Mississippi farms; a part, perhaps the major part, has been used as feed for the increased livestock population.

Livestock numbers in Mississippi have varied from time to time over a long period of years. There have been periods when livestock production was increased, followed by periods when livestock production was diminished. Various causes have been suggested for these variations, the competition of high-priced cotton being a favored one.

It seems logical to assume that Mississippi farmers have selected and pushed those agricultural enterprises best suited to their production facility, and yielding, or promising to yield, the most profit. Whatever the cause of the fluctuation in livestock population—whether the competition of high-priced cotton or the disappointing financial returns too often received from livestock, or whether too much was expected of livestock — the basic need of more livestock on Mississippi farms is and has been acute, and is further emphasized by war needs of the present and an undetermined future period.

It appears, also, that considerable numbers of farmers in favored areas have profited by livestock production, and that smaller numbers of farmers having exceptional facilities in less favored areas have also profited from livestock production. That is, livestock production is easiest in the natural grass- and clover-growing areas, such as the prairies and limited parts of the brown loam area; but farmers have successfully produced livestock in other areas where they were especially interested, or where markets were better than average, or where personal interest and love of livestock were combined with adequate financial resources.

Livestock Opportunities in Mississippi

Undoubtedly there have been failures and disappointments in livestock production in all areas of Mississippi. Undoubtedly, also, there have been successes. In view of the successful and large-scale production of livestock in relatively unproductive areas of the United States—namely, in the West, where as much as 40 acres of land is required for each cow and her calf—there appears no valid reason why beef cattle cannot profitably be produced in Mississippi, where pasture herbage grows much more profusely, even under unimproved conditions.

It has been the experience of the Mississippi Agricultural Experiment Station over a period of approximately 50 years that beef cattle can be profitably produced (prevailing prices permitting) whenever certain minimum requirements are met. These minimium requirements are low, and are within the reach of many thousands of farmers. They are:

1. **A minimum-for-efficiency investment in land for pasture** which is adequately fenced and so prepared that mowing or clipping may be done at least twice a year. The establishment of desirable pasture grasses and legumes by seeding or sodding is highly desirable but not absolutely necessary for profit.

2. **A minimum-for-efficiency investment in the breeding herd.** Purebred or high-grade beef cows and registered beef bulls are desirable but not absolutely necessary for profit. Good results have been had from South Mississippi native cows and registered beef bulls.

In view of the urgent need for the increased production of meat to supply war requirements, and in view of the continuing need for better balanced agricultural production in Mississippi, it is believed that recent experience by the Mississippi Station may be of value and real service to large numbers of State farmers who wish to begin livestock production but who desire some information as to what the outcome may be.

Observations by Mississippi Station

In the early spring of 1941, the Station purchased 80 South Mississippi native cows and divided them into 4 lots of 20 cows, each headed by a registered Hereford bull, for use in a minerals experiment. One lot was placed on the long-established, minerals-rich pastures of the Station at State College, and three lots were placed on minerals-deficient pastures in a "flatwoods" land-use experimental area provided by the Federal Government. Calves produced in 1942 were marketed in Montgomery, Alabama.

Also in the early spring of 1941, 30 South Mississippi native cows and a registered Aberdeen Angus bull were purchased for the Holly Springs Branch Experiment Station, principally to utilize pasture made unfit for milk production because of wild onion infestation.

Fifty South Mississippi native cows and a registered Hereford bull were purchased for the Natchez Branch Experiment Station, for use as a foundation herd and for miscellaneous livestock and breeding experiments; 25 of these cows were purchased in January and 25 in September, 1940. A registered Hereford and a registered Polled Hereford bull were provided.

In the early spring of 1942, 180 native South Mississippi cows were purchased for the use of the Experiment Station in a land-utilization project on a portion of a 4000-acre tract supplied by the Soil Conservation Service of the Federal Government. These cows were range-bred at the time of purchase, and produced native calves in 1942, but were bred to registered bulls for the 1943 and 1944 calf crops.

Variety of Circumstances in Test

Thus, all of the cows used were South Mississippi natives, and showed little or no admixture either of dairy or beef breeding. Most of them were horned, and while there was no uniformity of color, reds, whites, and mixtures of red and white, predominated. Sizes varied considerably, but on the average the South Mississippi native cows appeared somewhat larger than the grade Jersey cows prevalent in north Mississippi, and there was a considerable increase in size after a year or more on good pasture. The native cows seemed to have a good flow of milk. Their calves, when sired by beef-type bulls, compared fairly well with calves from high grade beef cows in the Station herd at State College.

During the program of beef production, varied progress has been made in improving the breeding herds. All cows in the Holly Springs and in the State College herds were acquired in the original purchase. A limited number of first-cross heifers have been added to the Area herd, to produce first calves in 1945. The herd at Natchez has been almost completely changed by saving grade heifer calves and disposing of native cows as soon as the grade heifers started production.

The pastures used represent four separate soil types: prairie soils, flatwoods soils, thin-phase brown loam soil, and deep-phase brown loam soil. Treatments used in establishing these pastures varied from the bare minimum of mowing, to a schedule of recommended pasture practices: seeding, fertilizing, and mowing. The acreage grazed per cow varied quite widely. The calves were marketed on four separate markets, such as commonly used by car-lot livestock shippers in Mississippi.

The wintering programs at the four locations include a variety of methods of wintering beef cattle in Mississippi: the maximum use of low grade roughages at Holly Springs, the State College ration based largely on silage and cottonseed meal at Natchez, hay secured from pasture clippings and stacked in the pastures at State College, and hay produced for the specific purpose of wintering the beef herd in the Area.

The data presented are not given on a cost-accounting basis, and the increases in value shown do not represent net profit. Interest on investment is not calculated, nor is the cost of labor and of feed used in wintering shown. The effort is to present details of a beef-calf producing program based on minimum-for-efficiency expenditures and such as can be carried into effect on many thousands of Mississippi farms.

Beef Calf Production At Natchez Branch Station

The Natchez Branch Experiment Station is located in the deep phase of the brown loam area on land which is fairly representative of this section. The terrain might be described as rolling hills which vary from gentle slopes to abrupt vertical drops. Although erosion is a serious problem in a large part of this area, it is nevertheless one of the most fertile areas in the hill section of the State.

On August 1, 1939, the work of the Natchez Station was changed from research on general farm problems to a program which is primarily concerned with livestock, pasture, and forage crops. The approximately 240 acres now used for pastures includes areas which for several years have been divided up and used for different purposes. Part had been in pastures, part in cultivation, part in meadows, and part had grown up in young timber. Most of it was suffering from erosion, and in many places well established gullies were causing considerable damage. Vegetation consisted largely of native hop clover and lespedeza, with small amounts of carpet and bermuda grasses. Bushes and briars had made heavy growth in places, and in some instances the clover and grasses had been entirely crowded out by them.

Pasture Development

In the fall of 1939, the work of fencing, building ponds, and clearing away bushes briars, and trees was started.

Due to erosion problems the Station wa placed under a soil conservation program in the spring of 1940, and a large par of the pasture land was terraced, and terrace outlet ditches were constructed. All of the pasture area was fertilized with basic slag and TVA phosphates at the rate of 40 pounds P_2O_5 per acre, with the exception of certain test plots. Dallis grass was seeded in March 1940, at the rate of 15 pounds per acre. At this time common lespedeza was also seeded at the rate of 10 pounds per acre, and White Dutch clover was seeded that fall at the rate of 4 pounds per acre. Every year since 1940 one application of 40 pounds P_2O_5 per acre has been made with the exception of 1943, and at this time two applications were made. At present (De-

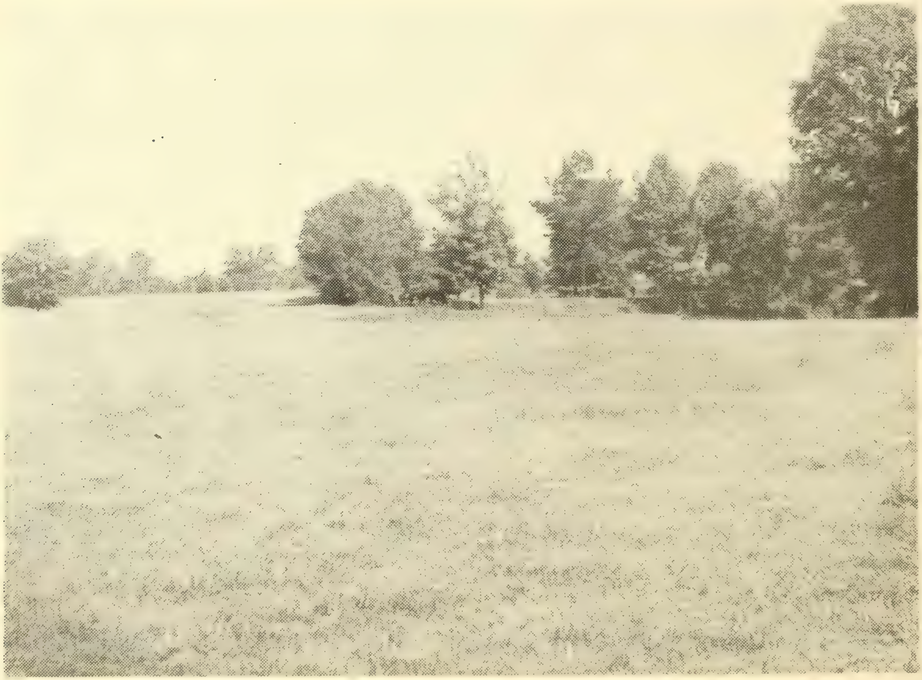

Figure 1. A pasture at Natchez Branch Station, fertilized with phosphate, limed, and seeded to White Dutch clover, common lespedeza, and Dallis grass.

cember 1944), 2,000 to 4,000 pounds per acre of agricultural lime obtained through the AAA is being applied. Mowing was started at the beginning and has been done twice each year since.

Enough TVA phosphate and basic slag were acquired in 1940 to last through 1943, and were obtained through a grant of aid without cost to the Station. Superphosphate was purchased in 1944. To apply 40 pounds P_2O_5 per acre, TVA phosphate was applied at the rate of 67 pounds per acre; basic slag, 500 pounds; and superphosphate, 200 pounds. The table which follows shows the approximate cost of seed and fertilizer for each of the 5 years included in this report. To approximate these costs, definite values approximating purchase cost is assigned to the TVA phosphate and basic slag. Fertilizer was not applied to the entire pasture area every year, and the cost is therefore reported on a per acre basis.

This makes a total cost of $18.55 per acre over the 5-year period, or an average of $3.71 per year. The price of the three phosphate materials used in the project has remained about the same throughout this period; thus the price of $2.00 per 40 pounds P_2O_5. Payments obtained through the AAA for mowing, seeding, fertilizing, and terracing have gone a long way toward defraying the expense of labor involved in these operations. Lime being applied at present is not included in the the table, for it is being applied for pasture crops of following years. The only cost involved in the liming operation, however, is $1.50 per ton for spreading.

With the aid of the Soil Conservation Service many thousands of kudzu plants have been set out along gully banks, several of which extend out into the pastures. In three of these gullies concrete structures have been installed in the heads of the ditches in an effort to stop the movement of soil.

Native South Mississippi Cows Used in Project

To initiate the research program with beef cattle, 50 head of native South Mississippi cows were purchased from Pearl River, Stone, and Lamar Counties. In addition to the cows, two registered bulls. one Polled Hereford and one Hereford. were purchased to cross on the cows with the idea of grading up. The cows showed little or no blood introduced from the improved breeds and were rather typical of their kind.

These cows have been confined to the pastures entirely since they arrived at the Station, and have not had access to any kind of shelter or barn during the winter. In the winter they have been fed the standard State College wintering ration for beef cattle, which is made up of the following feeds fed daily per 1,000 pounds liveweight:

30 pounds sorghum silage,
5 pounds grass hay,
1 pound cottonseed meal.

Last winter, grazing crimson clover reduced the feed bill considerably, and several acres of crimson clover and oats

Table 1. Cost of seeding and fertilizing pastures: Natchez, 1940-1944

Treatment	1940	1941	1942	1943	1944
40 pounds P_2O_5 per acre	$2.00	$2.00	$2.00	$4.00	$2.00
Dallis grass, 15 pounds per acre @ 15 cents (1940)	2.25	——	——	——	——
White Dutch clover, 4 pounds per acre @ 40 cents (1940)	1.60	——	——	——	——
White Dutch clover, 3 pounds per acre @ 50 cents (1942)	——	——	1.50	——	——
Common lespedeza, 10 pounds per acre @ 12 cents (1940)	1.20	——	——	——	——
Total cost per acre per year	7.05	2.00	3.50	4.00	2.00

Table 2. Financial statement for production year 1944, Natchez beef calf production project

Value of cattle on hand at beginning of 1944	
27 cows @ $65.00	$ 1,755.00
4 calves, heifers @ $45.00	180.00
9 yearling heifers @ $55.00	495.00
11 2-year-old heifers @ $70.00	770.00
2 bulls @ $200.00	400.00
Total value cattle on hand	$ 3,600.00
Sales during 1944	
Aug. 24, 1944, 9 calves average weight 361.1 pounds	$ 414.87
Mar. 2, 1944, 14 cows with calves	945.25
Mar. 16, 1944, 8 cows with calves and 1 2-year-old heifer	662.00
Total value cattle sold	$ 2,022.12
On hand December 1, 1944	
5 cows @ $65.00	$ 325.00
8 calves, heifers @ $45.00	360.00
4 yearling heifers @ $55.00	220.00
9 2-year-old heifers @ $70.00	630.00
10 3-year-old heifers @ $70.00	700.00
2 bulls @ $200.00	400.00
Total value cattle on hand	$ 2,635.00
Value sales plus value cattle on hand	4,657.12
Increase in 1944 over investment at beginning of year	1,057.12

Figure 2. The beef herd at Natchez. Here the original herd of native South Mississippi cows have been replaced by their grade Hereford daughters and granddaughters.

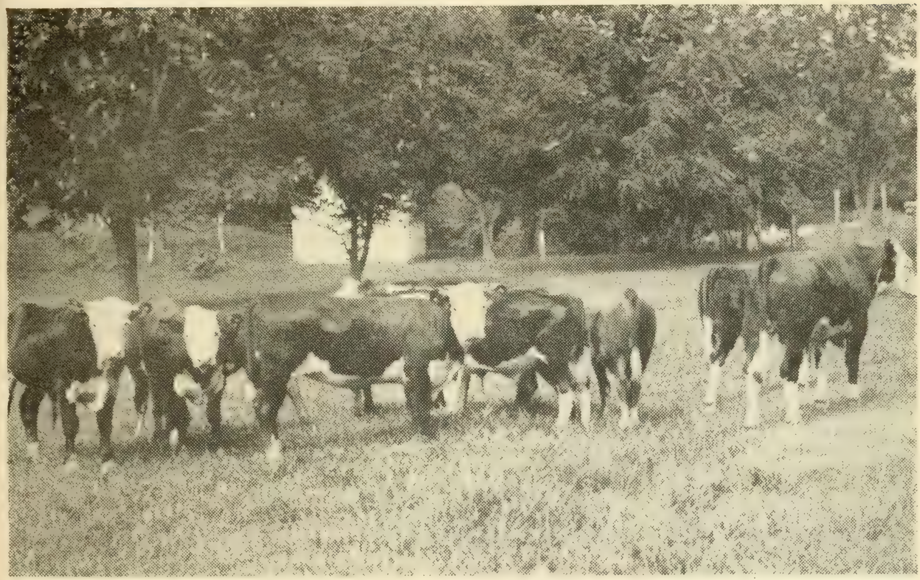

Figure 3. Grade Hereford calves produced at Natchez in 1944.

promise to cut down on the bill even more this winter.

In an effort to hasten the program as rapidly as possible these cows were bought and put on pasture within a year from the time that improvement on pastures first started. This proved to be unsatisfactory for several reasons. First, the pastures were overstocked before they were producing sufficient forage to properly support the number of cattle on them. This had caused pasture development to be unusually slow in spite of fertilizing, seeding, terracing, and mowing. Second, calf crops for the first 3 years were extremely low. It seems possible that at least a part of this might be attributed to a lack of nutrients necessary to maintain the cows in a proper state of reproduction. Third, if enough time had been given the pastures to properly establish themselves at first, it is likely that they would have supported this number of cattle without trouble.

There were at least two other factors which affected calf crops along with a lack of pasturage. These were contagious abortion and a change in breeding habits. This change in breeding habits was brought about by restricting the length of time and also the time of year that bulls were permitted to run with the cows. At that time it seemed desirable to have calves dropped within a limited period so that they would be about the same age and weight at marketing time. Therefore, bulls were kept on pasture with cows 3 months out of the year, usually from the middle of May to the middle of August. Previous to the time these cows were brought to the Station they had been permitted to run with bulls over a longer period and in some instances as long as the entire year. Contagious abortion caused the loss of several calves. However, through testing and the elimination of reactors, and by vaccinating all heifers that were to be retained in the herd, it seems that the disease has entirely disappeared.

Temporary Pasture

In March 1940, several acres of kudzu

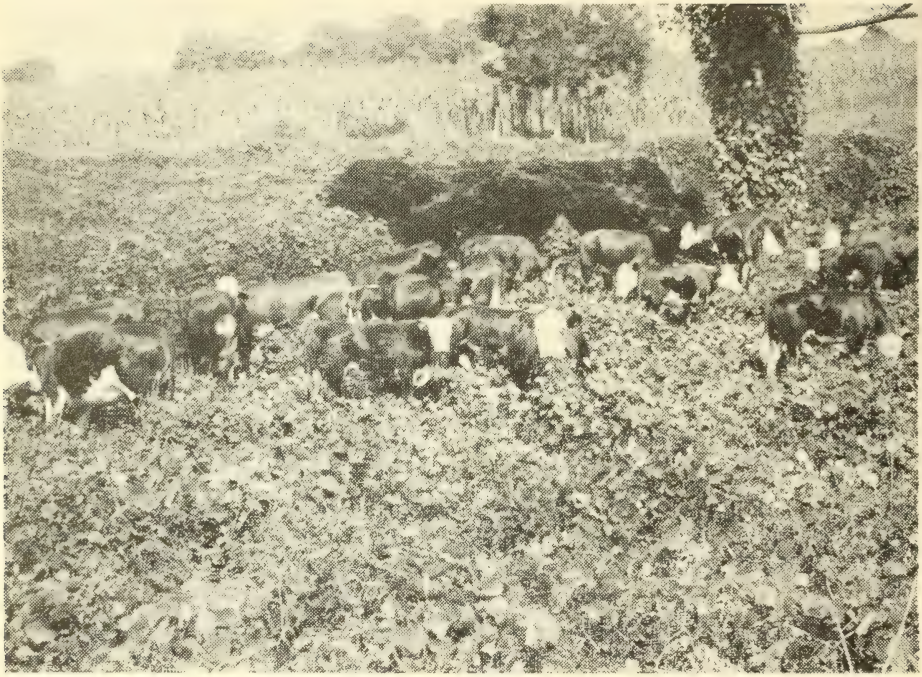

Figure 4. The beef herd at Natchez knee deep in kudzu.

was set out on the Station as a means of erosion control and also to provide temporary pasture and hay if necessary. It was set out along gully banks and on steep, badly eroded hill sides, which were too steep and rough for profitable row-crop production. Among the areas set to kudzu was a 7-acre paddock on such a hill side as previously described. The first 2 years after it was set out, two rows of corn were grown between the kudzu rows. By the third year the kudzu had made such growth it was thought best not to grow corn in it again, but rather to let it become better established. In October 1942, just before frost one and one-half tons of hay per acre was harvested. In January 1943, the land was disked three times with a disk harrow, which resulted in a thicker stand and a higher quality hay the following growing season. The summer of 1943, however, proved to be very dry in this section, and pastures reached a dangerously low state of production. To help off-set this lack of pasturage, on June 4, 31 head of cattle, consisting of 23 cows, 7 calves, and 1 bull, were turned in on the 7-acre paddock of kudzu. The cows and calves were weighed on July 2, but no record was kept on the weight of the bull.

Weights for the 28-day period were:

Average weight of both cows and calves, June 4—627 pounds.

Average weight of both cows and calves, July 2—645 pounds.

On July 7, six yearling heifers were placed on the 7-acre kudzu paddock and were kept there until August 27. They were taken out at this time to prevent overgrazing the kudzu. The weights of the cattle in this test were as follows.

Average weight July 7—512 pounds.

Average weight August 27 — 587 pounds.

The results show a gain of 990 pounds of beef produced during the 79-day grazing period, or 141.43 pounds produced per acre. This was produced on an area three-fourths of which was too steep and rough for crop production.

Since the cattle were of various grades, including a bull, cows, calves, and heifers, and were not marketed at the end of the test, an estimate of the value of the kudzu grazing can be only roughly approximated. Danger of seriously overgrazing the dry permanent pasture was averted. The cattle were kept in good condition, whereas, had the kudzu or other temporary grazing not been available, the cattle would have depreciated in condition and value.

It is to be emphasized that the kudzu was used in an emergency; had the kudzu been grazed at the rate of one animal per acre over a longer period, it is likely that much higher total gains would have been secured.

Size of Herd Cut in Half

Due to the severe penalties of overstocking it was decided to sell about one-half the herd in the spring of 1944. In March all but five of the remaining natives in the herd were sold. Several of the old, undesirable cows had been weeded out and sold prior to this time. Practically all of these cows sold in March were either heavy springers or had calves at the side. From the original 50 head, plus their off-spring over the 5-year period, this leaves a total at present of 36 in the herd. This number includes 5 natives, 10 three-year-old first-cross heifers, 9 two-year-old first-cross heifers, 4 one-year-old first-cross heifers, 1 first-cross heifer born this spring, and 7 second-cross heifers born this spring. These 7 second-

Table 3. Summary of results of beef calf production project, Natchez: 3 years, 1942, 1943, 1944

	1942		1943		1944	
	No.	Value	No.	Value	No.	Value
Investment in breeding stock						
Cows	46	$2,530.00	41	$2,255.00	27	$1,755.00
Calves, heifers	11	495.00	9	405.00	4	180.00
Yearling heifers			11	605.00	9	495.00
2-year-old heifers					11	770.00
Bulls	2	400.00	3[1]	600.00	2	400.00
Total cattle investment		3,425.00		3,865.00		3,600.00
Sales						
Cows	5	212.03	13	977.49	23[2]	1,607.25
Calves	17	604.70	11	474.41	9	414.87
Bulls			1	177.60		
Total sales		816.73		1,629.50		2,022.12
On hand December 1						
Cows	41	2,255.00	27	1,755.00	5	325.00
Calves, heifers	9	405.00	4	180.00	8	360.00
Yearling heifers	11	605.00	9	495.00	4	220.00
2-year-old heifers			11	770.00	9	630.00
3-year-old heifers					10	700.00
Bulls	2	400.00	2	400.00	2	400.00
Total value cattle on hand		3,665.00		3,600.00		2,635.00
Increase over investment in breeding stock (value sales plus value cattle on hand minus investment)		1,056.73		1,364.50		1,047.12
Total value cattle in breeding herd at beginning 1942						3,425.00
Total sales during 3-year period						4,468.35
Total value cattle on hand Dec. 1, 1944						2,635.00
Total increase of original investment during 3-year period						3,678.35

[1] 1 bull bought.

[2] Includes 1 2-year-old heifer.

cross heifers are out of the 10 three-year-old first-cross heifers. The other three, 3-year first-cross heifers, dropped bull calves, which were sold as steers in the early fall. The nine 2-year first-cross heifers were bred their first time this past summer. The others will be bred as soon as they become 2 years old.

Beef Calf Production At Holly Springs Branch Station

The Holly Springs Experiment Station has two farms of about 200 acres each some 3½ miles apart. There is some pasture land on each farm, practically all of which is too rolling for cultivation and much of it once gullied hill sides, reclaimed by terracing and sodding, after this Station was established. On the north farm something more than 40 acres is in pasture, of which about one-third is woodland. On the south farm there is between 90 and 100 acres in pasture, some 20 of which is in woodland. Most of the land on the south farm has been in pasture for years, but approximately 20 acres was in cultivation until put into pasture after the beef animals were introduced. About 7 acres of this last named land is set to locust trees and furnishes little grazing, but the cows reduce the fire hazard.

This new acreage was first sowed to lespedeza in the spring and later set to bermuda sod. Some 50 acres in the old south farm pasture had for years been partially sodded to bermuda, lespedeza, and hop clover, with a little Dallis and very little blue grass in scattered places.

In 1938 a carload of basic slag, donated by the Tennessee Coal and Iron Company was scattered over parts of the old south farm, and shortly before 1937, TVA phosphates were applied over some 5 or 6 acres. No exact figures have been kept, but since the application of the phosphates the pastures have improved greatly so that during the past two very dry summers the 90-odd acres has supported 26 to 30 head of grown cattle and about half as many calves. The herd of beef animals is grazed from about April 1 to December 1 on the south farm, but in the main is wintered on the north farm where much of the hay, sorghum, and corn stover is saved. During the summer the pasture on the north farm is used for dairy heifers and a few dry dairy cows.

Pasture Management

The practice used to establish new pasture from land taken out of cultivation has been to sow 20 pounds of common lespedeza seed per acre in the early spring, later opening furrows some 4 feet apart and putting in bermuda sod, usually while the ground was too wet for other farm work. Also where pasture clippings have contained seed of desirable pasture plants, such as hop clover, bur clover, blue grass, or Dallis grass, these clippings have been spread over new pasture with the idea of having the seed further spread by droppings from cattle eating them.

One or more times each year the pastures are clipped to keep down bitter weeds and promote succulent growth, and there is frequently enough grass to make it worth saving, and all is put in stacks in pasture. In addition, whenever grains such as oats or wheat are threshed, the straw is so stacked and frequently is eaten while the pastures are still fairly green. A further source of non-marketable roughage is inferior hays, injured by rains, that are also stacked for these beef cattle and which they entirely consume. In 1943, practically all hill corn failed to make ears on account of drought. This was cut with binder, stacked in field, and hauled from there every other day and fed to the beef animals. Other corn, making ears, has been so stacked and the grain taken off before feeding. Perhaps sorghum, usually planted late after small grain, has furnished the cheapest and most satisfactory feed, giving decidedly the largest yields, and being consumed,

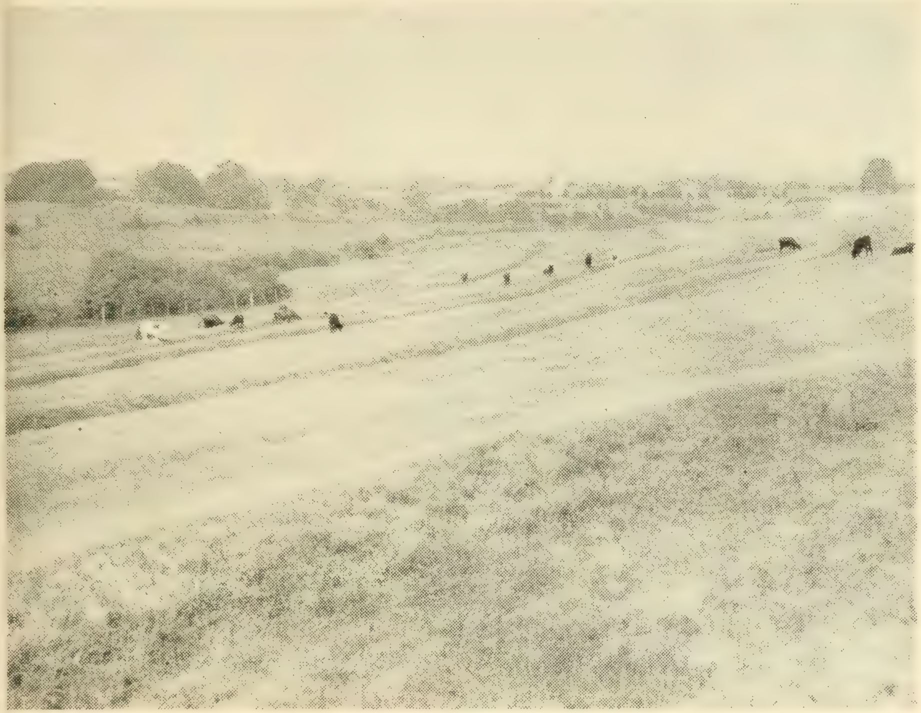

Figure 5. Beef cattle pasture at Holly Springs. Note terraces to prevent erosion. A portion of this pasture is new, remainder is long established.

stalk and all, more completely than corn stalks, by the beef cows.

Feed Used for Wintering

Practically no feed has been bought for the beef animals. Last winter, when little hay had been made following a disastrously dry summer, less than 1,000 pounds of cottonseed meal was fed on silage to these cattle. In 1944 some 15 acres of pure Japanese sorghum seed were planted, about half of it after grain crops cut for hay. Much of it matured seed which will be saved in an effort to distribute pure seed. Half of this sorghum was made into silage after cutting off most of the seed, and the other half cut with corn binder and stacked in field. Not all the sorghum planted after grain matured seed, much depending on the ability of the land to hold moisture during extreme drought; but following late rains, all made good growth. Some planted after grain made 10 tons of green forage per acre and that planted early made 15 tons of silage per acre.

This herd was wintered October 31, 1942, to January 16, 1943, on approximately 12.5 tons of pasture clippings and poor quality hay, the best hay having been saved for mules and dairy cattle. From January 17 to March 31 they were fed in pasture on about 14.9 tons of corn stover on which there was approximately 5.8 tons of ear corn. All the latter had been cut from late planted Jarvis corn, shocked in the fields, and fed without housing. The hay was largely fed from stacks in the pasture. The estimated selling price of the feed would not exceed $400.00 and the manure was worth more

Figure 6. The second lot of beef calves marketed at Holly Springs in 1944. These are out of native South Mississippi cows and sired by a registered Aberdeen-Angus bull.

than the cost of the labor used in feeding and handling the cattle.

Other Points of Interest

Unusual success has been had in the high percentage of calves obtained since the work was started. This has possibly been due to keeping the bull always with the herd, as well as to selling off all calves when they attain an average weight of 400 pounds. This possibly causes the

Table 4. Financial statement for production year 1944, Holly Springs beef calf production project

Value of cattle on hand at beginning of 1944	
26[1] cows	$ 1,690.00
5 calves	82.80
1 bull	200.00
Total value cattle on hand	$ 1,972.80
Sales during 1944	
23 calves	$ 1,121.50
Total sales	$ 1,121.50
On hand December 1, 1944	
24 cows	$ 1,560.00
7 calves	134.20
1 bull	200.00
Total value cattle on hand	$ 1,894.20
Value sales plus value cattle on hand	3,015.70
Increase in 1944 over investment at beginning of year	1,042.90

[1] 2 cows died in 1944.

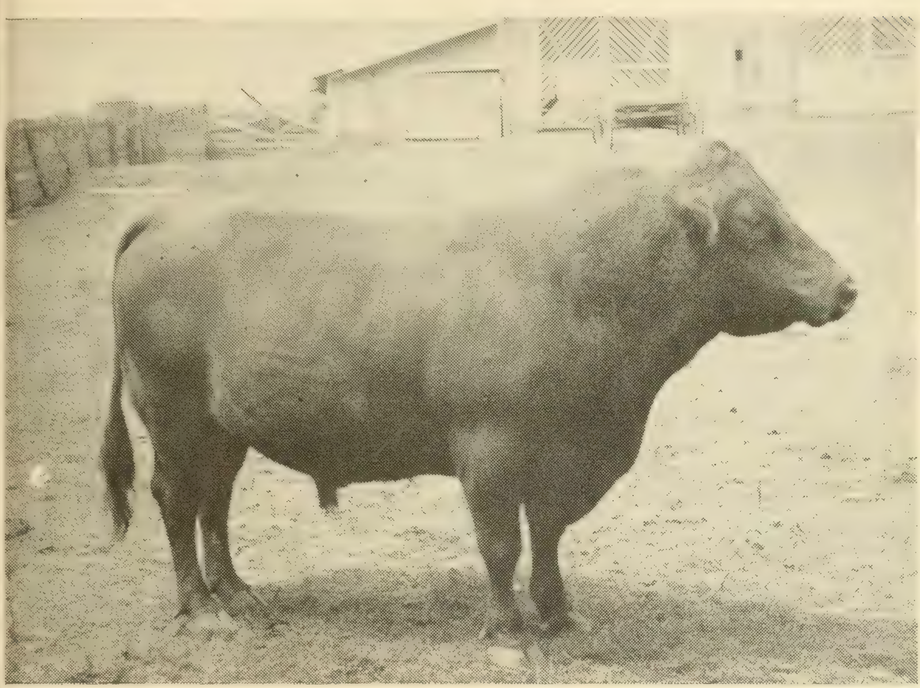

Figure 7. Herd bull at Holly Springs, sire of calves shown in figure 6.

cows to breed earlier than they might if the calves were suckled for longer periods of time. Being so near the Memphis market, it is possible to sell these calves whenever ready for market. Thus in 1944, eight calves were sold on June 30, six on August 22, and nine on October 31. The calves sold averaged 395 pounds in weight at Memphis. Every cow in the herd brought a calf during the 12-month period ending October 31, 1944.

Financial Statement

On October 31, 1942, there were five calves on hand weighing 740 pounds. They were too young to sell and were kept through the winter. On July 8, 1943, these five calves and one other were sold in Memphis, weighing 2,928 pounds and bringing $346.53. On August 17, largely because of drought and poor pasture, 16 calves weighing 6,394 pounds were sold and brought $767.28, and one non-breeding cow weighing 832 pounds, brought $83.20. On November 15, 9 calves were sold, weighing 2,638 pounds in Memphis and bringing $260.95. Thus there were sold in 1943 a total of 31 calves weighing 11,960 pounds and bringing $1,374.76; also one cow was sold for $83.20. These calves sold at from 9 to 12.5 cents per pound which appeared to be a cent or more lower than the same grade of calves sold for the year before.

Except for losing two cows on October 29 and 30, 1944, due to some kind of poison obtained while gleaning cultivated fields on the south farm, the financial success with these cattle was good. There were 23 calves sold for $1,121.50, this being an average of 12.2 cents per pound. On November 18, seven calves too young to sell weighed 1,100 pounds, and at the same valuation per pound would have an estimated worth of $134.20; or a total

Figure 8. The breeding cows at Holly Springs, dams of calves shown in figure 6. These cows have produced approximately 100 percent calf crops for 3 successive years.

calf crop of $1,255.70. Left on hand were 24 cows weighing 20,670 pounds, worth 8 cents per pound or $1,653.60, and one bull weighing 1,510 pounds for which $200.00 was paid in the beginning.

Cost of Feed

The cattle have been fed nothing except roughage grown on the farm and on one or two occasions small amounts of cottonseed meal, the most in any one winter having been in 1944 when about 1,000 pounds were fed. When hays or sorghum stover has been fed, some 18 to 20 pounds per cow per day has served to keep the animals in fair condition. On one occasion when corn stover was fed, a record was kept of the amount and was 12.5 pounds of the stover and 6.5 pounds of ear corn contained thereon, fed daily to each cow. No creep feeding has been done with calves and they have received nothing except mother's milk and such feed as they got in pasture, hays, etc.

Beef Calf Production On the Oktibbeha-Winston Land Use Experimental Area

The flatwoods area in Mississippi is a relatively narrow strip of land extending from near the Tennessee line in a southeasterly direction and entering Alabama about midway of the Mississippi-Alabama line, and includes portions of 13 counties. As a whole, flatwoods soils are usually classified as among the least desirable in Mississippi. As the name would indicate, they are level or gently undulating in conformation but unfortunately are deficient in essential plant nutrients.

Flatwoods soils are made up of plastic clay materials and the lack of undersurface drainage makes them susceptible to injury either by drouth or excessive rain-

Table 5. **Summary of results of beef calf production project, Holly Springs: 3 years, 1942, 1943, 1944**

	1942		1943		1944	
	No.	Value	No.	Value	No.	Value
Investment in breeding stock						
Cows	32[1]	$1,050.00	29[2]	$1,838.40	26[4]	$1,690.00
Calves	--	--------	5	88.80	5	82.80
Bulls	1	200.00	1	200.00	1	200.00
Total cattle investment		1,250.00		2,127.20		1,972.80
Sales						
Cows	--	--	1	83.20	----	--------
Calves	23	1,209.32	31[3]	1,374.76	23	1,121.50
Total sales		1,209.32		1,457.96		1,121.50
On hand December 1						
Cows	29	1,838.40	26	1,690.00	24	1,560.00
Calves	5	88.80	5	82.80	7	134.20
Bulls	1	200.00	1	200.00	1	200.00
Total value cattle on hand		2,127.20		1,972.80		1,894.20
Increase over investment in breeding stock (value sales plus value cattle on hand minus investment)		2,086.52		1,303.56		1,042.90
Total value cattle in breeding herd at beginning 1942						1,250.00
Total sales during 3-year period						3,788.78
Total value cattle on hand December, 1944						1,894.20
Total increase of original investment during 3-year period						4,432.98

[1] Cattle purchased spring 1941, 2 cows died and 1 sold in 1941.

[2] 2 cows died in 1943.

[3] Total weight of 31 calves 11,960 pounds or 385.8 pounds average.

[4] 2 cows died in 1944.

fall. When land is left idle, broom sedge takes charge and after 4 or 5 years it makes up in some cases almost 100 percent of the vegetative growth, completely crowding out other desirable pasture plants. In addition to the growth of broom sedge, all tracts reclaimed in this unit contained considerable growth of briars, small trees, brush and other undesirable plant growth.

The acreage leased to the Mississippi Experiment Station includes hill, second bottom or terrace, and bottom land, with approximately one-half hill and one-half bottom and second bottom. The bottom and second bottom land lies along Noxubee River and its tributaries and is considered to be above the average in fertility for flatwoods soil. In 1941, approximately 100 acres of bottom and second bottom land was planted to corn and the yield ranged from 20 to 50 bushels per acre. The flatwoods soil in general, however, is considered to be rather hazardous for row crop production due to poor drainage.

Approximately 50 percent of the 3,000 acres of land included in this tract is covered with second growth timber and no effort has been made to clear the timbered acreage. It was thought that the cost of clearing the timberland for use in pasture would be excessive, and that the timber crop might be more profitable than the pasture produced, cost considered. Therefore, only that part of the tract that has been in cultivation in the past 10 or 15 years has been reclaimed for pasture use.

The hill soils in the flatwoods area are generally classified as Lufkin and Susquehanna; the second bottom or terrace soils as Kalmia and Myatt; and the bottom land soils are classified as Iuka, Mantachie, and Bibb.

Pasture Development

The initial phase of pasture development in the flatwoods area was described

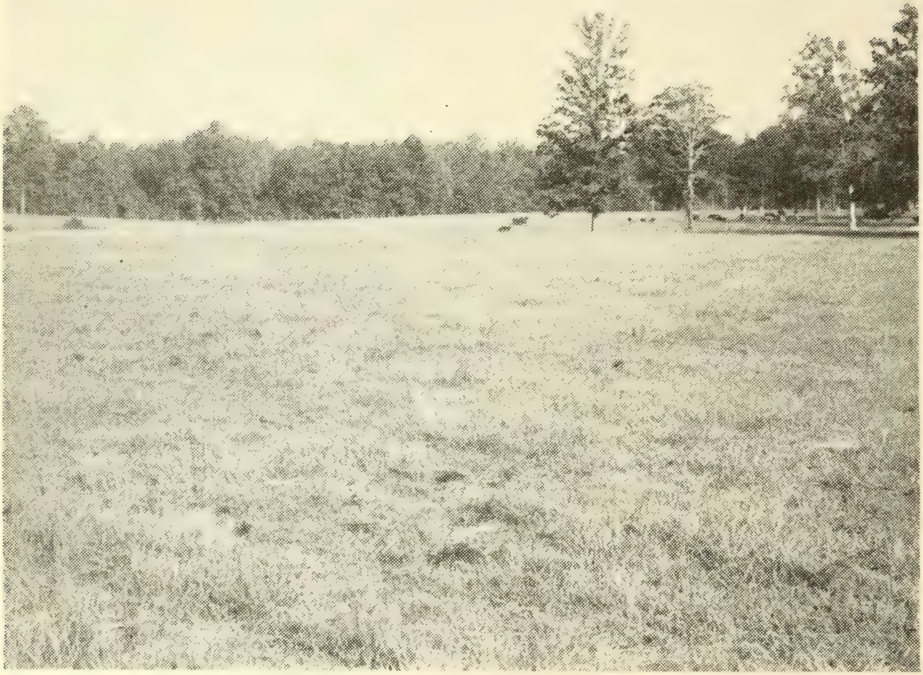

Figure 9. Upland pasture on flatwoods soil of the Area, phosphated and limed for 4 years, but not seeded. Thorough preparation and seeding was found to bring quicker and more economical pasture returns. Another portion of same pasture, which received same treatment, sheet eroded, is almost 100 percent broom sedge.

in Mississippi Experiment Station Bulletin 371 and Circular 108. Since the dates of these publications, several hundred acres of bottom, terrace, and hill land have been reclaimed and developed into permanent pasture. In general, the following procedure has been followed: (1) burning; (2) clearing land of brush and briars and other vegetative growth that did not burn; (3) disking with bush and bog disk harrow; (4) disking with pulverizing disk; (5) harrowing with section or drag harrow; and (6) seeding.

It was found that by first burning the sedge grass, the following operation of cutting the brush and small trees was greatly simplified. The land was cleared during the winter when the undergrowth would readily burn and on most of the property, clearing the land of brush, trees, and briars, constituted the most expensive operation. The cost of this operation, of course, was dependent on the amount of brush and trees present. Axes and crosscut saws were used to cut the brush and trees, and Kaiser blades were used for briars and small brush. All of this growth was cut at or below the surface of the ground in order to enable the operation of mowing machines.

In some cases the brush was piled and later burned; in other cases the brush was drug off the cleared land with a tractor and chain. This was done only with late clearing when there was not ample time for drying before time to plant seed.

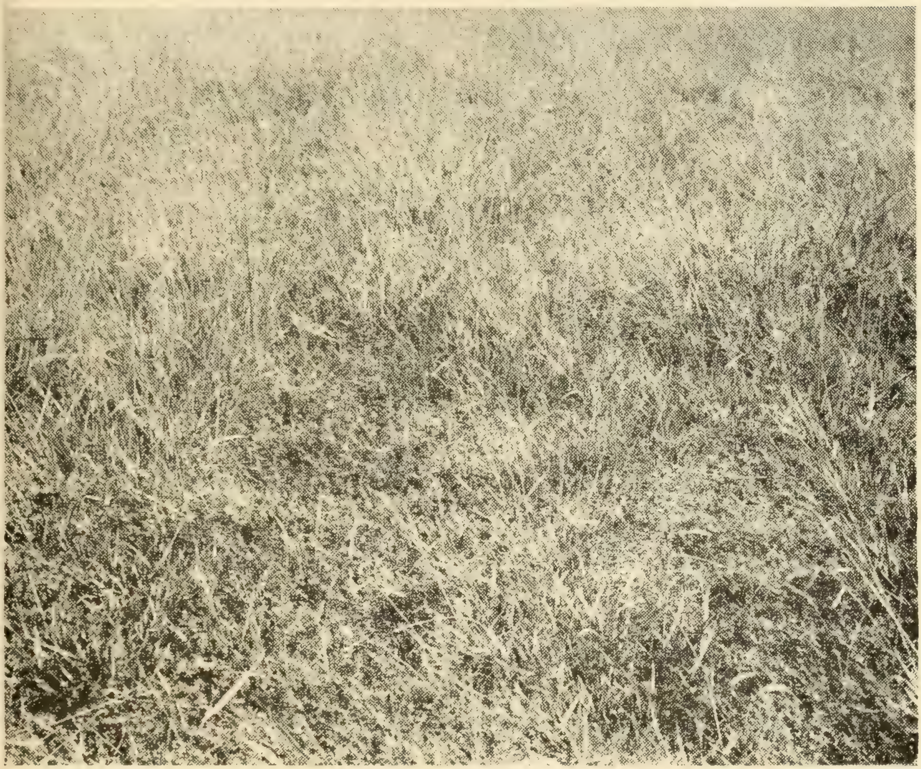

Figure 10. A close-up of the sod of the pasture shown in figure 9, selected to show a good mixed population of Dallis grass and lespedeza.

It was found that burning the brush was cheaper than dragging it off the land.

The tillage operations were carried out in order to prepare a seedbed and to destroy as nearly as possible the broom sedge which was present on all land cleared. The bush and bog disk harrow was used to do the first job because of its weight. The eight, 26-inch, scalloped disks not only turned out the broom sedge roots but also many roots of the small trees and brush. In double cutting the land, no ridges were left, and when followed by a pulverizing disk and drag harrow, a fair seedbed was made.

Other implements might be used in preparing a seedbed, but on account of the presence of stumps and roots, it was thought that plowing with mouldboard tractor plows would not be successful. A tractor disk plow might be used. Regardless of the method used in seedbed preparation, it is necessary that a reasonably good seedbed be made prior to planting Dallis grass and possibly other pasture seed on this type of soil, if good results are expected. This is particularly true on sedge grass-infested land.

Pasture Seeding

The pasture plants that have given best results thus far on flatwoods soil are Dallis grass and common lespedeza. White Dutch and Hop clover seed have been planted but up to date little or no grazing has resulted from these early spring clovers. Both imported and native Dallis grass

Table 6. Financial statement for production year 1944, Area beef calf production project

Value of cattle on hand at beginning of 1944		
211 cows[1] @ $65.00		$13,715.00
54 calves, heifers @ $45.00		2,430.00
16 yearling heifers @ $55.00		880.00
11 bulls @ $200.00		2,200.00
Total value cattle on hand		$19,225.00
Sales during 1944		
Sept. 8, 67 calves average weight 355.4 pounds		$ 3,026.70
Oct. 31, 70 calves[2] average weight 366 pounds		
69 calves	$2,919.27	
1 calf dead	4.12	
Total		2,923.39
Nov. '44, 14 calves average weight 313 pounds		508.80
Sept. '44, 4 calves average weight 377 pounds		187.30
2 cows		145.80
5 bulls		586.40
Total cattle sold 1944		$ 7,378.39
On hand December 1, 1944		
199 cows		$12,935.00
22 calves, heifers @ $45.00		990.00
54 yearling heifers		2,970.00
16 2-year-old heifers		1,120.00
6 bulls		1,200.00
Total value cattle on hand		$19,215.00
Value of sales plus value of cattle on hand		$26,593.39

[1] 10 cows died in January 1944, because of poison from eating phosphate left in pastures.
[2] 7 calves in 10/31/44 shipment out of 2-year-old heifers.

seed have been used. The native seed was planted in the fall and early spring, and the imported seed was planted only in early spring, March and early April. Poor results were secured from native Dallis grass, regardless of the date planted. Excellent results were obtained from the spring (March and early April) planting of imported seed. Generally unfavorable weather conditions during the past few years may have been responsible for some of the negative responses suggested above.

The Dallis grass seed was planted with a single row planter at the rate of about 5 pounds per acre. The planter was equipped with an agitator and a 4-inch shovel plow which made the furrow in which the seed was dropped. The seed was not covered by the planter. Being planted in a loose furrow the seed was directly in contact with moist, firm soil and the succeeding rains covered them with the necessary dirt for proper germination. The 5 pounds of imported seed planted in drills 3 feet apart was considered ample for drills so spaced. There was not a complete cover of Dallis grass the first year nor in places the second year, while in other areas there seemed to be a rather complete cover of Dallis grass the second year. Perhaps 10 pounds of seed planted in 18-inch drills would have given a complete cover of Dallis grass the second year and in certain areas the first year.

Common lespedeza seed were sown at the rate of 20 pounds per acre with a cyclone seeder at the same time the Dallis grass seed was planted, or in March and early April, and the seed was not covered.

The total cost of making pastures on the various tracts of land naturally was quite variable, depending upon the type and the amount of vegetation to be removed and also on the kind of pasture established. The average cost of clearing, seedbed preparation, and seeding, was approximately $12.00 per acre.

Fertilizing Pasture Land

The fertilization work with pastures on the flatwoods unit has not progressed far enough for any conclusive results to be reported. Lime, phosphate, and a fertilizer mixture containing nitrogen, phosphorus and potash, have been used. One 80-acre tract of hill land has been fertilized with 600 pounds of lime and 70 pounds of P_2O_5 each year for the past 4 years. Other tracts have been fertilized only one time, some with phosphate alone and other tracts with the fertilizer mixture. In no case have the fertilizer treatments been carried far enough for conclusive results. The results up to date indicate that poor results are obtained when phosphate and lime are applied to hill land with only the native vegetative cover or where no seedbed has been prepared and no seed of desirable pasture species planted. The results of the fertilizer work carried on during the past 2 years indicates that a fertilizer mixture containing nitrogen, phosphorus and potash applied at the time of seeding might be given consideration, to be followed by annual or biennial applications of phosphate and lime.

As general recommendations for pasture development and improvement in the flatwoods area, the following might be given: (1) a well prepared seedbed; (2) a minimum of 5 pounds of Dallis grass seed of known quality and 20 pounds of common lespedeza seed, both species can be planted at the same time

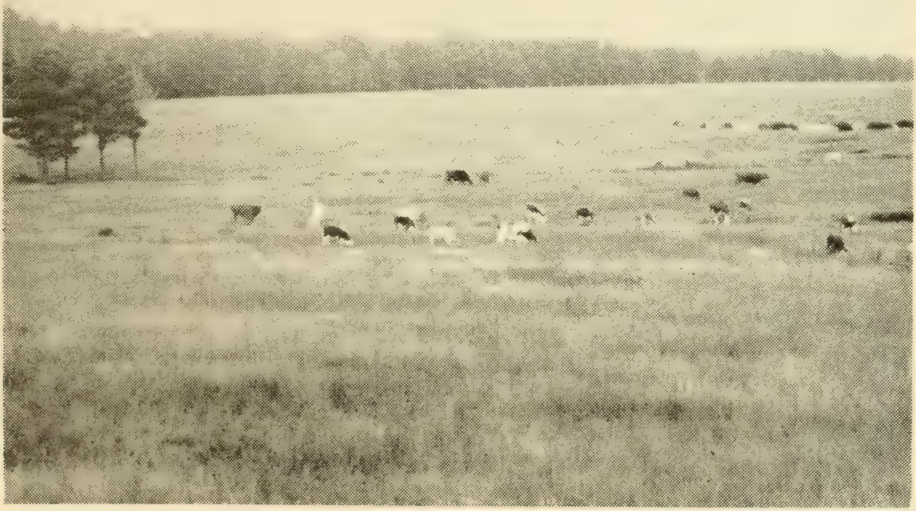

Figure 11. A flatwoods pasture neither seeded nor fertilized, but mowed 1 to 3 times every year since 1941. Cows grazing it—4 acres per cow and calf—produced 400-pound calves. Photographed in August 1944.

in March; (3) necessary fertilizer; (4) frequent mowing; (5) grazing regulated, especially to prevent overgrazing while plants are getting established.

Beef Cattle Management in Flatwoods Area

Beef cattle production began in the flatwoods area in February 1941 with the purchase of 60 South Mississippi native cows and 3 registered Hereford bulls. In February 1942, 173 more South Mississippi cows and 6 more registered Hereford and Angus bulls were added to the Area herd. Thus, during the past 3 years, a breeding herd of more than 200 cows have been carried on this unit.

Objectives in View

The major objectives in establishing a beef cattle herd on flatwoods soil were:

1. To determine whether or not beef cattle could be profitably and successfully produced on this soil type.

2. To determine the most suitable and adaptable species and combinations of species of plants for permanent and temporary grazing.

3. To study winter and summer management problems in connection with the operation of a beef cattle production unit in the flatwoods area.

4. To determine the most practical amounts and kinds of fertilizer to be used on flatwoods soil in the production of pasture and forage.

It should be kept in mind that the information given in this publication is only a progress report and is not the final answer to many problems involved in the operation of a beef cattle unit in this area.

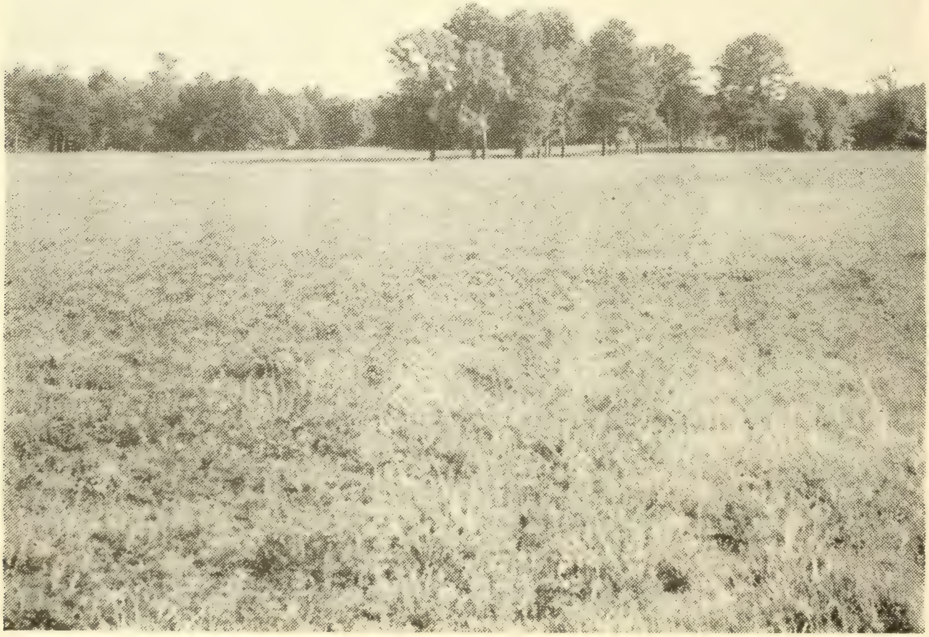

Figure 12. A bottom land flatwoods pasture that was brush and briars in 1942-43. It was cleared, prepared, fertilized, and seeded to Dallis grass and lespedeza early in 1943; phosphated August 1944.

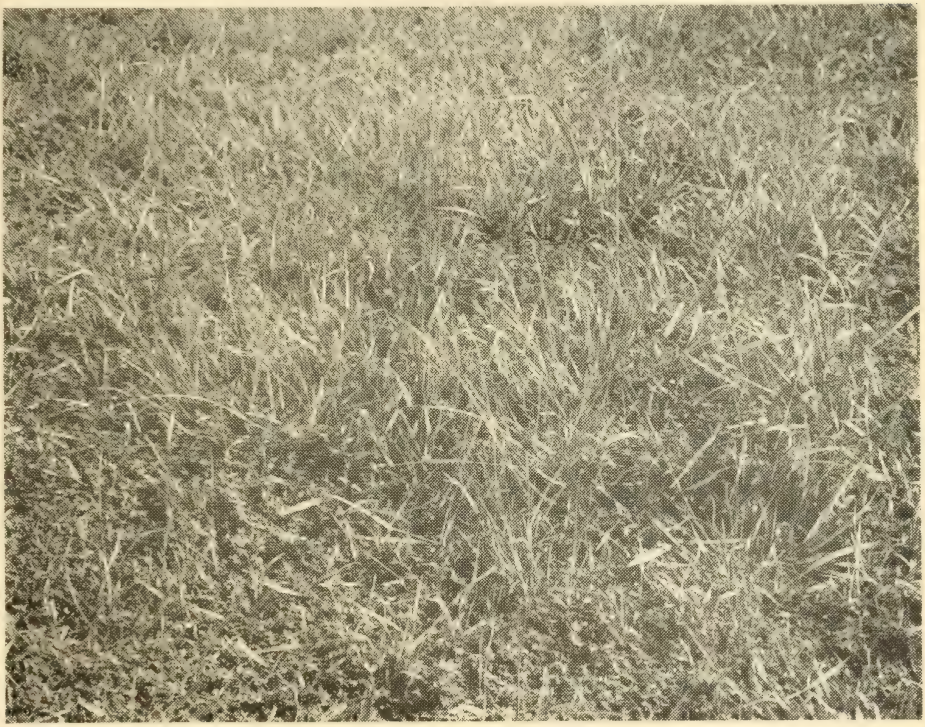

Figure 13. Close-up view of sod in seeded and fertilized pasture shown in figure 12. Rows in which Dallis grass was seeded are evident, with lespedeza between grass rows.

Phases of Beef Cattle Production

As would be expected, only one major phase of beef cattle production is being studied in this work, namely beef calf production. The foundation herd of common or native cows is bred to beef-type registered bulls to produce first-cross calves to be sold at weaning time, so that the only income from a herd of this kind is from milk fat calves and cull cows and bulls. There are other phases of beef cattle production that should be given consideration in order that the grass and forage may be marketed to the best advantage. In some instances the calves might be sold as feeder calves, or carried over, roughed through the winter, and then marketed as long yearling feeders the following summer or fall, or they might even be carried through another winter and sold as grass-fat 2-year-olds. This phase of beef cattle production, however, might require the use of better quality and more expensive, foundation cows. The final answer to many problems of this nature is the phase or combination of phases of beef cattle production that will be most profitable under a given set of circumstances, or the phase that will return the most net income per acre of pasture or per unit of forage. It should be kept in mind, also, that the major purpose of beef cattle on farms is to consume surplus forage, pasture, or feeds, that otherwise have little or no market value.

Winter Management of Herd

At the beginning of the beef cattle work in the flatwoods area, the plan was to winter the herd as far as possible on hay that had been stacked in pastures and meadows. On account of unfavorable weather condition it has been necessary to alter the original plans somewhat, but the general plan of stacking the available hay and letting the cattle eat from stacks has been adhered to.

The herd of 200 or more breeding cows has been carried through two winters, 1942-1943 and 1943-1944, most of the cows being purchased in February and March 1942.

The summer of 1942 was favorable for lespedeza, and enough hay was produced and stacked in the meadows to carry the cattle until about February 15th. Approximately 1 pound of cottonseed cake per cow per day was fed from February 15th to April 1st or until grass was available in the pastures. With this system of feeding hay, there is always more or less wastage of hay around the stack. To allow for this waste and enough hay to carry a cow through the winter, approximately 2 tons of hay per mature cow has been required. A large part of the waste might be eliminated by fencing the stacks and feeding the hay daily in improvised racks near the stacks. However, the rack method involves the use of more labor than is necessary where cattle are allowed access to the stacks. More research work should be done on the various methods of feeding hay to cattle during winter.

The summer of 1943 was most unfavorable for lespedeza growth, consequently very little hay was stacked for the 1943-44 winter. Only about 50 acres of the 250-acre meadow was mowed and most of that cut was baled for barn feeding. The lespedeza on the remaining 200 acres was considered to be too short to cut for hay and was left for winter grazing.

About December 1, 20 thin cows were put on the lespedeza meadow, and on December 20 the remainder of the herd was started on 1 pound of cottonseed cake per head per day. On January 20 the amount of cottonseed cake was increased 1 pound per cow and all cows were allowed the range of meadows as well as pastures. About 87 percent of the herd was carried through the winter on from 1 to 2 pounds of cottonseed cake per cow per day in addition to the roughage that they were able to pick up from unmowed meadows and from the pasture they had grazed the previous summer. About 13 percent of the total number became thin and were brought to the barn for more liberal feeding. The cows began calving in December, and 30 to 40 percent of the total number calved during December, January, and February.

Since 1942 a limited number of first-cross heifer calves have been added to the herd each year, 16 from the 1942 calf crop, 54 from the 1943 calf crop, and 22 from the 1944 calf crop. These calves have been wintered in the barn on hay and from 1 to 2 pounds of grain per head per day for approximately 120 days. The second winter, if stacked hay is available, they are left on pastures and meadows and managed in the same way as mature cows.

Summer Management of the Herd

It has been pointed out that the beef cattle herd on this unit has been carried on a minimum amount of supplemental feed; therefore, the cattle have been carried the maximum number of days on pasture. About April 1, all supplemental feeding has been discontinued and with the run of meadows, timbered land, and permanent pastures, the cattle are able to get a fill of green feed.

Up to date, none of the early clovers, such as Hop and White Dutch, have become established on this unit. When a sufficient amount of lime, phosphate, and potash has been applied, it is believed that these early clovers will become established, which will materially increase the length of the grazing period. Thus far the early grazing has consisted of native grasses, weeds and browse. From May

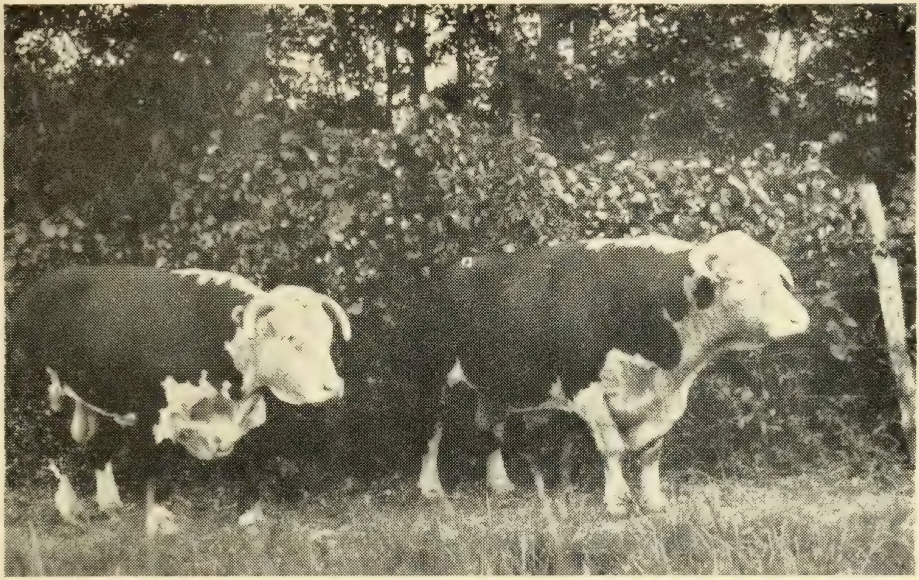

Figure 14. Two of the bulls used in the Area project. These are fairly representative of the type of bulls used at all locations.

1 to 15, Dallis and carpet grass is available and about June 1 lespedeza is ready for grazing. These plants supply the majority of grazing for the remainder of the season or until about December 15.

When pastures are established the first year, cattle are not allowed to graze continuously on the young plants. The pastures are carefully watched and when the plants are considered to be grazed too closely, the cattle are taken off and put on again when the plants have made further growth. This management practice may require additional fencing, but is necessary if good pastures are expected.

In the grazing program on this unit, every effort has been made to provide more grass than there were cattle to consume it. In other words, the plan has been to keep the amount of grass ahead of the cattle, for when there is a surplus of grass, pasture management is greatly simplified. New pastures as well as old ones can be protected from overgrazing and the condition of the herd is improved when cattle can be shifted so as to equalize the grazing.

With a herd of 200 cows or more, such as is being carried in this unit, better results are obtained if the pasture is cross-fenced so that the herd can be divided into one or two bull-unit groups or from 30 to 60 cows each. With this management practice, a closer check can be made on the breeding ability of bulls as well as females. On the hill land where unimproved pastures were used and where mowing was the only management practice in use, 4 acres have been provided per cow and calf. On the bottom and second bottom land, where good pastures have been properly established, the carrying capacity is probably doubled.

Beef Cattle Breeding Program

Under natural or range conditions, approximately 50 percent of all beef cows calve during the three spring months, March, April, and May. This would indicate that beef cows are probably most likely to come in heat and become settled with calf in June, July, and August. With one group of cows consisting of 60-odd head, a controlled breeding program has been followed during the past 4 years; that is, the bulls were placed with the cows June 1 and removed September 1. The cows in this group have been grazed on hill land with only the native vegetation available and wintered on low grade roughage with no shelter. The average calving percentage for 1942, 1943, and 1944 was 73, 62, and 90, respectively, or an average of 75 percent for the three calf crops. An 85 percent calf crop is considered normal under reasonably good management practices.

When milk-fat calves are to be sold in late summer or fall, the advantages of breeding cows to calve in winter might off-set the disadvantages. Ordinarily, cows that calve from December to April require more winter feed and attention than cows that calve during the spring months. On the other hand, a winter calf is heavier in the fall, and the increase in gross receipts as compared to spring calves will probably off-set the increased cost of feed. If a market is relatively close, where calves can be trucked in at any time during the year, bulls might be left with the herd the year round. With this system, calves can be marketed as they reach the desired weight. If it is necessary to market calves by rail or by long distance trucking,, a controlled breeding period might be more desirable even at the expense of a slightly reduced percentage calf crop. With one of the herds on the Area unit, bulls will be put with the herd on March 1 and removed from the herd September 1. Since most of the calves in this unit will be moved by rail, one shipment will be made in September for winter calves and another shipment

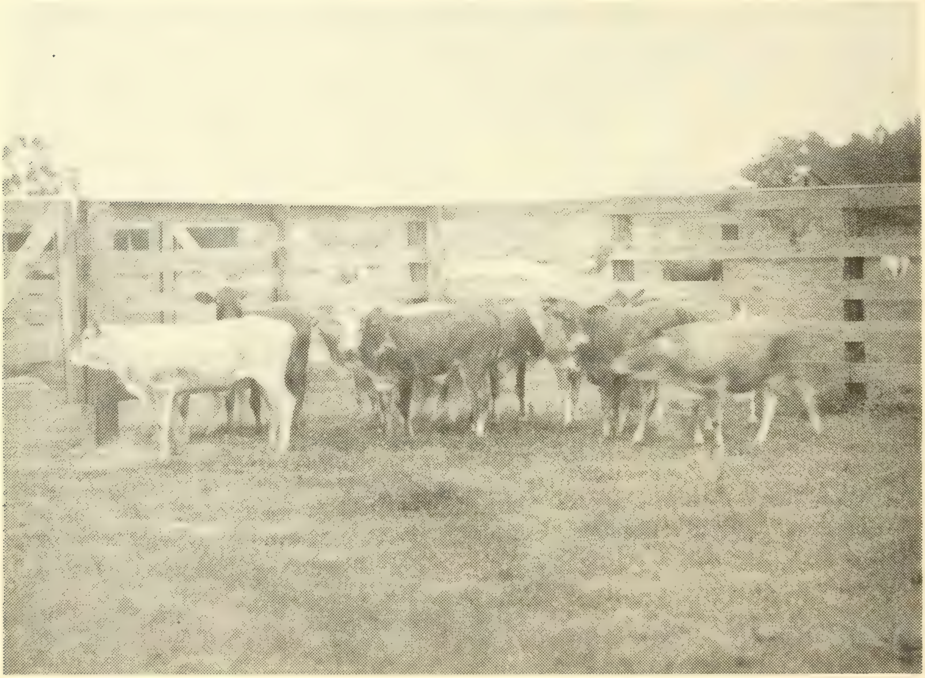

Figure 15. A Brahman bull was purchased and placed in the Area herd early in the 1943 season. Above are some of his get, out of native South Mississippi cows.

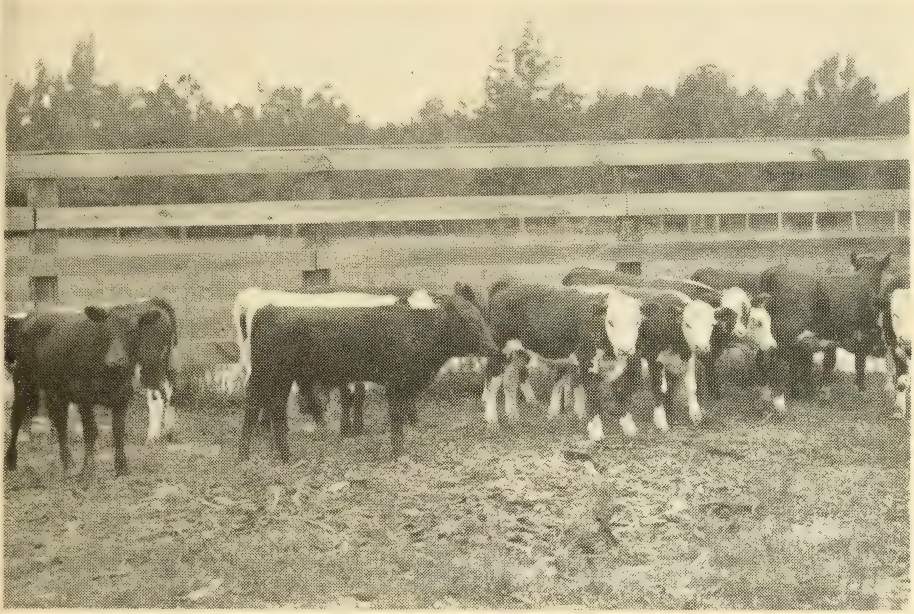

Figure 16. Area calves the day before they were marketed, out of native South Mississippi cows and sired by Aberdeen-Angus and Hereford bulls.

in November for spring calves. This practice will eliminate the summer calves which make poor gains and sell at less per pound than winter or spring calves.

General Summary of Beef Cattle Production on Flatwoods Soil

Since the spring of 1942, more than 200 breeding cows of native or nondescript breeding have been carried on the flatwoods unit for the purpose of beef calf production. Since the flatwoods soil represents quite a large area of the land in Mississippi and since this soil in general is poorly adapted to the production of row crops, the beef cattle work is being studied with a possibility that the soil in the flatwoods area might yield more returns in pasture and forage production than by row crop tillage.

In general, the results during the past 4 years with beef cattle on this unit have been very favorable. Mature native cows grazed on hill land consisting of Lufkin and Susquehanna soils have produced a 75 percent calf crop for 3 years, and the calves dropped in March, April, and May weighed on the average of 400 pounds by November. The land upon which these cattle grazed was cleared of brush in the spring of 1941 and has been mowed from one to three times annually. No seeding has been done. Approximately 4 acres of this type pasture has been required for one cow and calf during the grazing season. As compared to cows grazing on improved pastures on prairie soil, the flatwoods herd produced a 15 percent less daily gain from birth to weaning than did calves on prairie soil. With flatwoods pastures that have been improved by seeding and fertilizing and with more of the richer bottom land included in pastures, the efficiency of beef calf production is probably increased to compare favorably with that of prairie soils.

Feeding bonemeal to breeding cattle as a mineral supplement on flatwoods pasture has failed to yield any significant results. This would indicate that calcium and phosphorus are not limiting factors in beef calf production on Lufkin and Susquehanna soils.

In view of the fact that flatwoods soils left idle several years becomes covered with broom sedge, a thoroughly prepared seedbed for establishing a pasture is advisable. Frequent mowing is necessary. The permanent pasture plants that have given best results are Dallis grass and common lespedeza. Lime and phosphate applied to hill pasture land where a seedbed has not been prepared and seed planted, did not give significant immediate returns in terms of beef produced.

As a winter feed for beef cattle in this area, oats planted the latter part of August and early September on the better bottom lands should give good results. Common lespedeza has been used as a summer-growing hay crop. During dry summers, however, common lespedeza makes little growth. A satisfactory method of wintering mature cows is to give them access to stacked lespedeza hay or lespedeza-grass mixed hay. If the supply of hay is limited, 1 to 2 pounds of cottonseed cake per head per day has given satisfactory results. Approximately 2 tons of stacked hay should be provided for each mature cow. No sheds or barns have been used except for a few individuals.

There has been no apparent damage from internal or external parasites with the cattle handled in this unit. Only 60 cows of the total number have been tested for brucella abortus or Bang's disease and the percentage reactors was only about 2 percent. Bang's disease has

Table 7. Summary of results of beef calf production project, Area: 3 years 1942, 1943, 1944

	1942		1943		1944	
	No.	Value	No.	Value	No.	Value
Investment in breeding stock						
Cows	228	$ 9,660.19	214	$11,777.00	211	$13,715.00
Calves, heifers	----	....	18	677.00	54	2,430.00
Yearlings, heifers	---	....	----	....	16	880.00
Bulls	9	1,680.00	10[4]	1,880.00	11[5]	2,200.00
Total cattle investment		11,340.19		14,334.00		19,225.00
Sales						
Cows	5	338.55	--	....	2	145.80
Calves	147	4,351.01	50	1,937.50	155	6,646.19
Bulls	---	....	1	88.50	5	586.40
Total sales		4,689.56		2,026.00		7,378.39
On hand December 1, 1944						
Cows	214[1]	11,777.00	211[2]	13,715.00	199	12,935.00
Calves, heifers	18	677.00	54	2,430.00	22	990.00
Yearling heifers	---	....	16	880.00	54	2,970.00
2-year-old heifers	---	....		....	16	1,120.00
Bulls	9	1,680.00	9	1,800.00	6	1,200.00
Total value cattle on hand		14,134.00		18,825.00		19,215.00
Increase over investment in breeding stock (value sales plus value cattle on hand minus investment)		7,483.37		6,517.00		7,368.39
Total value cattle in breeding herd at beginning 1942						$11,340.19
Total sales during 3-year period						14,093.95
Total value of cattle on hand December 1, 1944						19,215.00
Total increase of original investment during 3-year period						21,968.76

[1] 9 cows died.

[2] 3 cows died.

[3] 10 cows died.

[4] Brahman bull purchased spring 1943.

[5] 2 bulls bought spring 1944.

caused little trouble in this herd up to date. The replacement heifers were vaccinated with Strain No. 19 Brucellous Abortus vaccine at about 6 months of age. With one exception, most of the losses that have occurred were due to cattle being thin and weak at the time of purchase, the exception being when 10 cows died from eating phosphate that had been left in sacks in the pasture.

With the added interest in forestry and forestry products during recent years, it might be of interest to note that forest when handled in connection with a beef cattle grazing program, such as has been true with this tract since 1941, is very largely protected against fires. There have been no fires of any serious consequences in the forest handled in this tract since 1941. The fire protection is brought about largely by relatively close grazing and mowing of the open land when, ordinarily, broom sedge and other vegetation constitute fire hazards.

Beef Calf Production at the Central Station, State College

In the spring of 1941, at the same time beef cattle work was started on the Oktibbeha-Winston Land Use Area, 23 native cows, out of the group purchased for the Area, were moved to State College to be used as a check lot group with those handled on the Area. The College herd has been managed as near like that of the Area group as possible, the major difference being soil and the fact that the College pastures have been established 30 or 40 years, while the flatwoods pastures were started in 1941. At the time the beef cattle work was started on the flatwoods area, it was thought advisable to make a study of a similar group of cattle on prairie pastures that were known to yield good returns for a number of years. Therefore, a gate-cut was made of the 90-odd South Mississippi cows purchased in the spring of 1941, one-fourth placed on the College pastures and three-fourths put on pastures in the flatwoods area. The ages of the cows purchased ranged from 3 to 7 years and no information was available as to their previous history or performance records. It was quite natural that some of these cattle coming from the range would be bred to calve in 1941. The number of calves produced by this herd in 1941 and 1942 as well as the sales record is reported in Mississippi Experiment Station Bulletin 371. The results given in this report, therefore, will cover only the 2-year performance records, 1943 and 1944.

Pastures at State College and Summer Management of Herd

The permanent pastures at State College are mostly on hill land or Oktibbeha clay soil in the northeast prairie section of the State. These pastures have been established for a number of years and until recently no minerals fertilizer has been added. During the past 2 years, phosphate has been applied to some of the pastures and basic slag to others. They have been mowed from one to three times annually.

Experiment Station records show that approximately 40 years ago in the early stages of pasture development in Mississippi, approximately 16 different species of seeds of pasture plants were sown on this land. As a result of these early seedings of practically all of the then known southern permanent pasture plants, only two, Dallis grass and hop clover, have carried through this period and are still producing the major part of the grazing. Hop clover is ready for grazing about March 20 and supplies from 80 to 90 percent of the total grazing until May 15. By May 15 Dallis grass is available and constitutes from 80 to 90 percent of the total grazing until December 15.

The beef cattle herd, therefore, is carried on permanent pasture with no supplemental feed from March 20 to December 15. The bull is placed with the

Figure 17. State College herd of cows, representative of all native South Mississippi cows used at the four locations.

Table 8. Financial statement for production year 1944, State College beef calf production project

Value of cattle on hand at beginning of 1944	
13 cows @ $65.00	$ 845.00
7 calves, heifers @ $45.00	315.00
7 yearling heifers @ $55.00	385.00
1 bull	200.00
Total value of cattle on hand	$ 1,745.00
Sales during 1944	
6 calves average weight 500 pounds @ 13 cents	$ 390.00
4 calves[1] average weight 425 pounds @ 12 cents	204.00
Total value of cattle sold	$ 594.00
On hand December 1, 1944	
13 cows	$ 845.00
6 calves, heifers @ $45.00[2]	270.00
7 yearling heifers @ $55.00	385.00
7 2-year-old heifers @ $70.00	490.00
1 bull	200.00
Total value of cattle on hand	$ 2,190.00
Value sales plus value cattle on hand	2,784.00
Increase in 1944 over investment at beginning of year	1,039.00

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[1] Calves out of 2-year-old heifers.

[2] Average weight 500 pounds @ 13 cents, market value $65.00 each

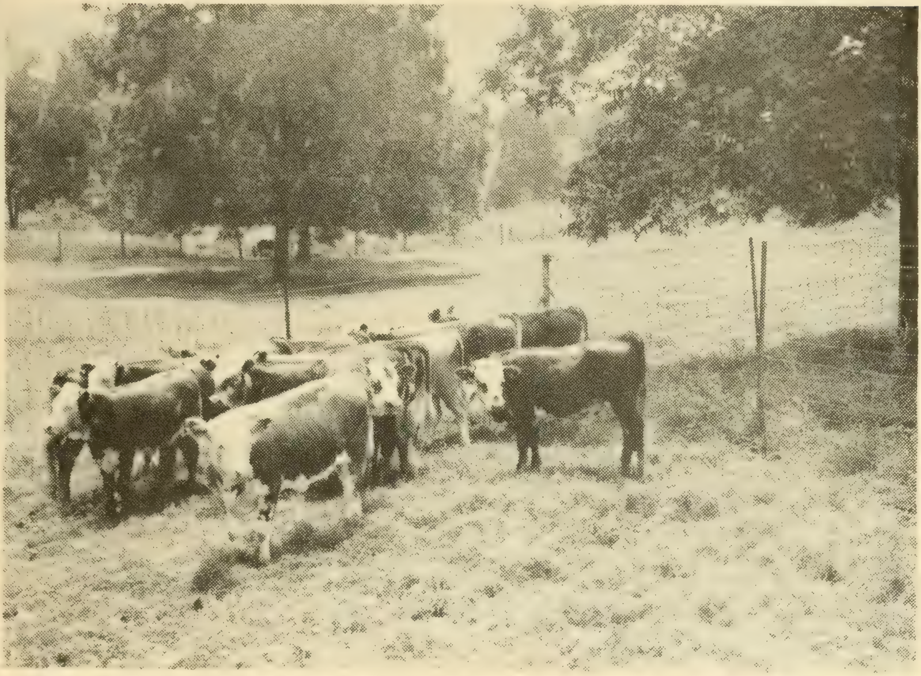

Figure 18. First-cross calves out of the native cows shown in figure 17, and sired by a registered Hereford bull. Averaged 500 pounds in weight when marketed about 2 months after photograph above.

cows June 1 and is removed September 1, the calving period being March, April, and May.

Winter Management of Herd

Except following exceedingly dry summers it has not been necessary to provide supplemental feed for the College herd from December 15 to March 20. With ample rainfall during the summer and early fall, there has been a surplus growth of Dallis grass which has been mowed and stacked for winter feeding. About 2 tons of pasture clippings per cow stacked around poles has proved to be one of the most satisfactory methods of saving feed for winter use.

It has been noted that the size of the stack is important and the bigger the stack the more satisfactory will be the results. Usually with a thick stand and a heavy growth of Dallis grass, and with the use of a buck rake, stacks ranging from 10 to 20 tons each are most practical. Where a number of stacks are made in one pasture, fencing them so as to allow the cattle to eat from only one stack until it is completely consumed reduces waste. In building stacks, pine or gum poles 6 inches in diameter have been used. These poles should be peeled so that the hay will slide down readily as it is eaten and should be placed at least 3 feet in the ground and well tamped.

Improperly built stacks are not only dangerous but cause wasted feed. Several tons of hay stacked around a pole that is not well set in the ground will invariably topple over if more hay is eaten from one side than the other. A pole may be well set in the ground, but if improperly trimmed or peeled or if too small it may cause trouble as the hay is

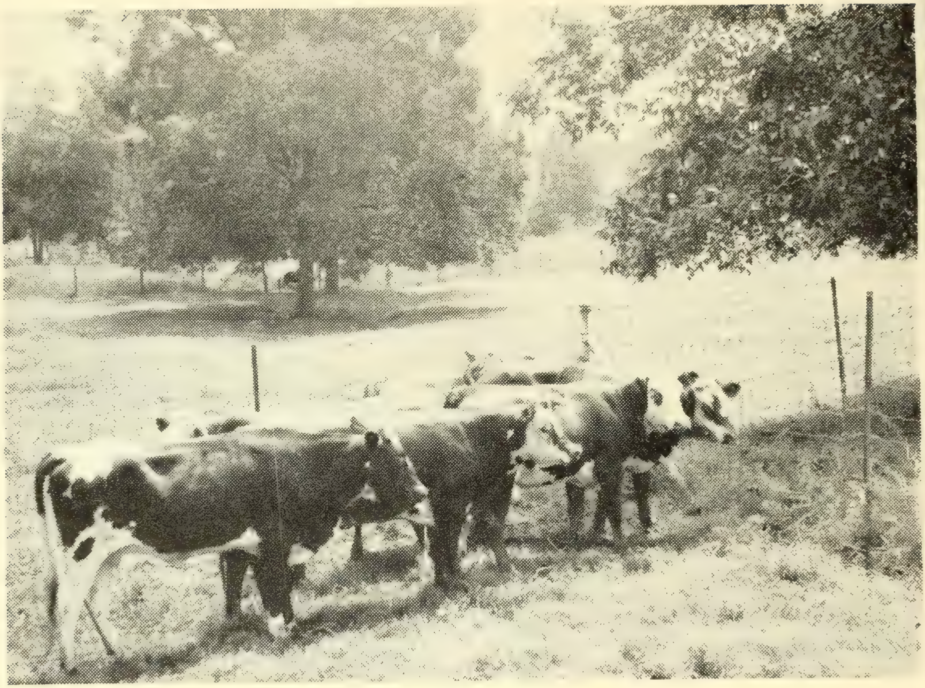

Figure 19. Yearling heifers, dropped in 1943 and photographed in August 1944. These are being developed for herd replacements.

eaten from around the stack. Cattle have been caught and killed by the top of the stack toppling over on them after the hay has been eaten from underneath.

This system of winter management of a breeding herd has several advantages: (1) It affords an economical and practical method of supplying supplemental feed during the wintering period; (2) it is equivalent to a cafeteria system of feeding with no labor involved in the feeding operation; (3) cattle are wintered out in the open and are not concentrated around muddy feed lots and barns where they are more likely to become infected with diseases; (4) the manure produced is left on the land where the winter feed was produced; (5) pastures should be mowed at least once during the growing season, which means that the only cost of the stacked clippings is the cost of stacking.

During the past season a cheap homemade power stacker was built and used on one of the units during the hay season, which reduced the cost of stacking by perhaps 50 percent and made it possible to save all the hay; whereas, with the present labor shortage, not all the hay produced could have been saved without the aid of a stacker.

Performance of College Herd, 1943-1944

All first-cross heifer calves produced by the College herd have been retained for replacement purposes. The steer calves produced each year have been disposed of in November. By referring to Mississippi Experiment Station Bulletin 371, the financial report can be followed through on this herd for 1941 and 1942, and the sales records for 1943 and 1944 are reported in this publication.

Table 9. Summary of results of beef calf production project, State College: 3 years, 1942, 1943, 1944

	1942		1943		1944	
	No.	Value	No.	Value	No.	Value
Investment in breeding stock						
Cows	18	$ 736.00	18	$1,169.00	13	$ 845.00
Calves, heifers	----	....	7	315.00	7	315.00
Yearling heifers	.	.....	.	....	7	385.00
Bulls	1	160.00	1	160.00	1	200.00
Total cattle investment		896.00		1,644.00		1,745.00
Sales						
Cows	----	....	5	200.00	...	....
Calves	9	422.07	6	311.85	10*	594.00
Total value cattle sold		422.07		511.85		594.00
On hand December 1, 1944						
Cows	18	1,169.00	13	845.00	13	845.00
Calves, heifers	7	315.00	7	315.00	6	270.00
Yearling heifers	----	....	7	385.00	7	385.00
2-year-old heifers	----	....	...	....	7	490.00
Bulls	1	160.00	1	200.00	1	200.00
Total value cattle on hand		1,644.00		1,745.00		2,190.00
Increase over investment in breeding stock (value sales plus value cattle on hand minus investment)		1,170.07		612.85		1,039.00
Total value cattle in breeding herd at beginning 1942						896.00
Total sales during 3-year period						1,527.92
Total value cattle on hand Dec. 1, 1944						2,190.00
Total increase of original investment during 3-year period						2,821.92

*4 calves out of 2-year-old heifers.

For the most part, this herd has consumed grass and clover during the pasture season and, when available, pasture clippings during the winter period. On account of the 1943 drouth, Dallis grass made little surplus growth and it was necessary to feed this herd silage, cottonseed meal and hay for about three months the following winter. About 30 pounds of silage, 1 pound of cottonseed meal, and 5 pounds of low grade grass hay per cow per day was fed for about 90 days during the winter of 1943-44. The supplemental feed in all cases has been hauled to the pasture and fed to the cows in open troughs and at no time has this herd been fed in a barn.

This herd has been culled rather rigidly and cows failing to calve the second year were disposed of. On the basis of this system of culling, the herd produced the following percentage calf crops: 1942, 83; 1943, 81; 1944, 92. The calves born in March, April, and May and weaned in November, have averaged 438, 475 and 495 pounds in weight, respectively, for the 3 years.

Identification of Cattle

In any well managed herd of beef cattle, an individual identification system is necessary. Regardless of the size of the herd, each animal should be identified so that its performance record can be checked and followed up. Various systems of identification are used, such as neck chains, ear tags, tattoo, ear notches, and brands. The first three methods are used in registered herds, while the two latter methods are more popular in commercial herds. The numerical brand is being used in this herd; that is, each animal is given a numerical brand on the hip. For no particular reason, the left hip is branded if no brands had been previously put in this area; if so, the right hip is branded. There is sufficient area in the triangle of the hip of mature cattle to allow for three 4-inch numbers, which means that this system can be used on any number of cattle up to 1,000 head. Factory-made copper brands are more satisfactory for branding than brands made from the ordinary waste shop iron or steel. The copper branding irons can be purchased either with or without shanks which can be made from ½-inch rod iron.

Dehorning, Castrating, and Vaccinating

All bull calves are castrated at from 1 to 4 months of age. Since there is usually quite a variation in age, it has not been practical to castrate at any certain age; and market calves can be castrated at from one day to several months of age, so long as the operation is done before secondary sex characteristics develop. Practically all Experiment Station bull calves are castrated with an emasculatome. Where cattle are handled under controlled pasture conditions, this method has proved to be satisfactory and is much more quickly done than by using the knife. At the same time the bull calves are castrated, all calves are vaccinated with blackleg bacterin.

Approximately 95 percent of the cattle purchased from the South Mississippi range area have horns. Cattlemen in that area seem to prefer horned cattle to polled cattle, since they are easier to rope. However, when cattle are controlled under fence, occasionally corralled, and are fed supplemental feed during the winter period, horns become dangerous and are responsible for much loss. Therefore, all cattle handled in these herds are dehorned. Young calves, up to 10 days or 2 weeks old that are to be kept in the herd, are dehorned with caustic, and dehorners are used on older cattle.

BULLETIN 414 MARCH 1945

Kudzu in the Ration of Growing Chicks

By H. D. POLK and MARVIN GIEGER

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KUDZU IN THE RATION OF GROWING CHICKS

By H. D. POLK and MARVIN GIEGER

There is an urgent need for a forage plant equivalent in feeding value to alfalfa and adapted to a wide variety of Mississippi soils, to be used in poultry rations.

Alfalfa meal is now widely used in commercial and home-mixed poultry feeds, in amounts ranging from 5 percent to 10 percent of the total. Properly cured alfalfa meal is considered a good source of provitamin A and riboflavin, and in addition carries liberal quantities of other food nutrients and is close to the feeding value of the succulent green plants.

However, during the war years alfalfa meal has been scarce, and the home mixing of poultry feeds has been made difficult because of inability to secure alfalfa meal or its equivalent on local markets.

It is highly desirable that poultry feed ingredients be produced whenever practicable on farms where used. Alfalfa is one of the lime-loving plants; it is produced without undue difficulty in the lime soils of the prairie and delta, but with considerable difficulty in the other sections of the State.

Kudzu, a legume and therefore high in feeding value, is being extensively planted primarily for erosion control on rough or eroded soils of Mississippi. To a lesser but increasing extent kudzu is being planted on the better soils, also, for hay production and summer grazing. It has made very good growth on all except poorly drained soils and soils with tight subsoils, and reported yields of kudzu hay have averaged about 2 tons per acre. Kudzu is similar to other plants in that it responds readily to fertilizer and makes heavier yields on the more fertile soils. It seems to be at its best on the sandy textured soils of southern, central, and northeast Mississippi, and on well drained silty soils of the Brown Loam area. Thus, kudzu is available to most farmers who cannot produce alfalfa.

An experiment was started in 1942 by the Poultry Department of the Mississippi Agricultural Experiment Station to determine the value of kudzu when used instead of alfalfa in chick starting rations. Kudzu is relatively new as a hay plant, and information is limited as to its food constituents, as well as to the proper time of cutting and methods of curing so as to preserve in the resultant hay the food nutrients of the green material.

Cutting and Curing Kudzu

Kudzu for the first and second series of the feeding experiment was cut during the latter part of July 1943, using a mowing machine equipped with a home-made attachment to hold down the vines so the blade could clip them easily. In good weather kudzu is easily cured, due to the fact that the leaves curl up when drying, thus allowing air to pass readily through the leaves and vines. It is easily handled since the vines are cut up by means of the home-made attachment mentioned above. The kudzu for this experiment was given time to wilt after cutting and then was piled in small shocks before night to prevent dew from turning it dark. The following day the kudzu hay was placed in a large room to finish drying. The kudzu for the third series of the test was cut during the latter part of August 1944, and cured by the same method as given for the 1943 period.

The kudzu leaf meal, which contained only the leaves, was secured by hand-stripping the leaves from the green plants. The leaves were spread on a concrete surface exposed to the direct rays of the sun for approximately one-half day before moving to a room to finish drying. The leaves of kudzu do not shatter or crumble readily when dry. When cured by the above method the kudzu hay and

Table 2. Average chemical analyses of alfalfa meal, kudzu leaf meal, and kudzu meal and of rations including these products, used during 3 feeding periods, 1944 and 1945.

	Moisture	Crude fat	Crude fiber	Ash	Protein	Nitrogen free ext.	Calcium	Phosphorus	Carotene micro. in 1 gm.	Riboflavin micrograms in 1 lb.
	pct.	pct.	pct.	pct.	pct.	pct.	pct.	pct.		
Analyses of meals:										
Kudzu meal	5.00	2.23	30.06	7.09	13.75	41.88	2.97	0.22	81.58	3,413.21
Kudzu leaf meal	6.90	2.80	17.98	9.01	18.94	47.67	2.43	0.28	128.96	5,289.97
Alfalfa meal (dehydrated)	6.39	2.85	24.49	7.58	17.75	40.94	1.38	0.33	67.32	7,906.94
Analyses of rations:										
Ration 1; including alfalfa meal 9 pct., milk 3 pct.	8.83	3.36	9.24	6.88	21.83	49.81	1.60	0.79	6.42	3,280.83
Ration 2; including kudzu leaf meal 9 pct.	8.31	3.62	8.10	7.30	21.21	51.33	1.66	0.78	18.71	3,164.53
Ration 3; including kudzu meal 9 pct., milk 3 pct.	8.41	3.61	9.42	7.26	21.96	49.36	1.63	0.80	7.64	3,638.96
Ration 4; including kudzu meal 10 pct.	8.43	3.84	9.95	7.08	21.50	49.18	1.64	0.79	6.76	2,982.17

leaves are bright green in color and have a pleasant aroma. The kudzu meal is ground kudzu hay, and contains both leaves and stems as harvested.

The kudzu hay and leaves were ground on a hammer mill approximately 2 weeks after cutting, packed in used dried-milk sacks, and stored in a cellar until ready to feed.

It is realized that the hand-stripping method employed to secure kudzu leaves for leaf meal, is laborious and costly. It was desired that kudzu leaf meal of high quality be included in the experiment, however, and it was not obtainable otherwise. Kudzu hay is being marketed to a limited extent, but is of uncertain quality. Since only a small portion of the poultry ration is kudzu (or alfalfa) it is believed that the method followed in curing and preparing kudzu meal is practicable until better methods are made available.

The chemical analyses of the kudzu used in the experiment are given in table 2.

Rations Used in Experiment

Four rations were used in the experiment (table 1), one including alfalfa meal as the control or basis of comparison. The remaining three rations included kudzu instead of alfalfa. Two of the rations contained dried milk at the rate of 3 percent as an additional source of riboflavin: lots 1 and 2. Thus, lot 1, the control ration, included alfalfa meal plus 3 percent dried milk; lot 2 included kudzu leaf meal, but no milk; lot 3 included kudzu meal plus 3 percent dried milk; and lot 4 included kudzu meal, but no milk. In addition, all rations included approximately equal amounts of yellow corn meal, wheat shorts, wheat bran, ground oats, shrimp meal, cottonseed meal, salt, and feeding oil. All chicks were fed granite grit biweekly throughout each experiment.

Ration 1 and ration 3 are directly comparable since both contain similar amounts of all ingredients, except that ration 1 contains 9 pounds alfalfa meal while ration 3 contains 9 pounds kudzu meal.

Kudzu leaf meal contains more of the essential feed ingredients than kudzu meal, and ration 2 (including kudzu leaf meal, no milk, but with 1 additional pound each of shrimp meal and yellow corn meal) was used to determine whether such a milk-less ration would be as satisfactory as rations containing dried milk.

Kudzu meal, though containing somewhat less of the essential feed ingredients, is much easier to produce on farms than kudzu leaf meal, and costs materially

Table 1. Rations used in comparisons of alfalfa and kudzu products for starting chicks.

Ingredients	Ration 1 Alfalfa meal plus milk	Ration 2 Kudzu leaf meal without milk	Ration 3 Kudzu meal with milk	Ration 4 Kudzu meal without milk
	pounds	pounds	pounds	pounds
Wheat shorts	10	10	10	10
Yellow corn meal	33	34	33	34
Wheat bran	10	10	10	10
Ground oats	10	10	10	10
Shrimp meal	14	15	14	15
Cottonseed meal	10	10	10	10
Kudzu	—	—	9	10
Kudzu leaf meal	—	9	—	—
Alfalfa meal	9	—	—	—
Dried milk	3	—	3	—
Salt	½	½	½	½
Feeding oil*	⅛	⅛	⅛	⅛

*3000 U.S.P. units of vitamin A and 400 U.S.P. units of vitamin D.

less when purchased. The kudzu meal ration (lot 4) was included to determine whether a satisfactory ration could be developed by the use of kudzu meal without milk. Ration 4 contained 1 pound more each of kudzu, yellow corn meal, and shrimp meal.

The rations given in table 1 were fed to carefully selected Barred Plymouth Rock males X White Leghorn female chicks during three feeding periods: November 27, 1943 to January 29, 1944; May 26 to July 20, 1944; and December 14, 1944 to February 15, 1945.

The chicks were brooded in a five-section battery brooder for a period of 5 weeks. At this period they were placed in a finishing battery until the end of the ninth week. Each week the chicks were shifted in the batteries to equalize temperature and volume of fresh air which could have influenced their growth if they had remained at a constant height from the floor level.

The chicks were weighed weekly, their feed consumption determined weekly, and they were watched for signs of nutritional deficiencies. Mortality was recorded as it occurred.

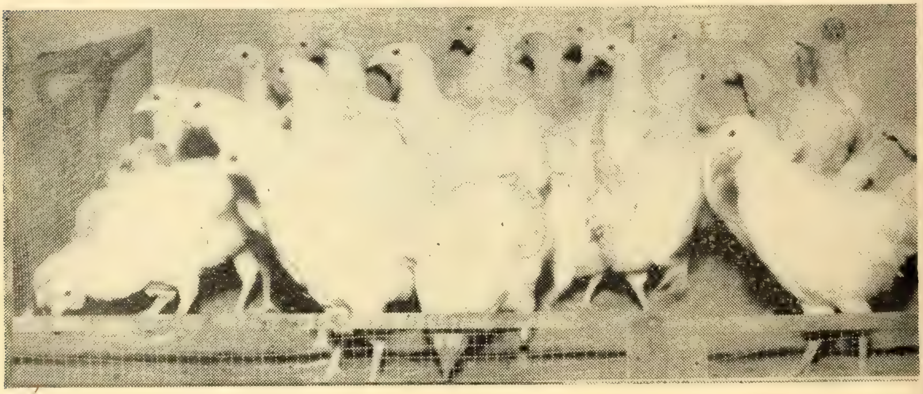

Figure 1A. Lot 1, Early Winter, 1944 Series; ration including alfalfa meal and dried milk.

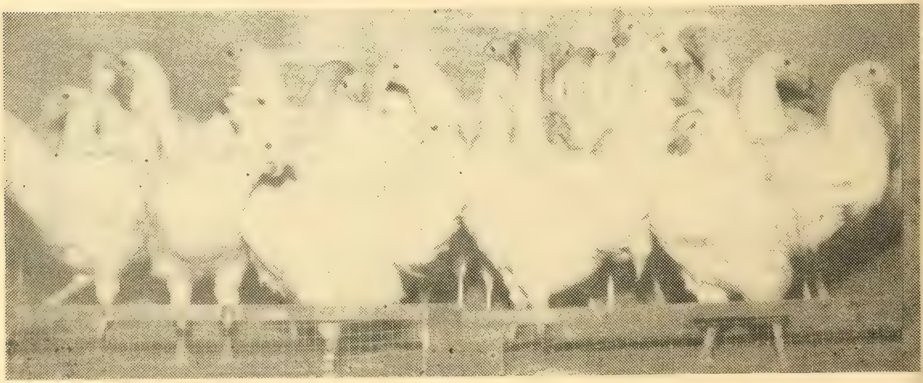

Figure 1B. Lot 2, Early Winter, 1944 Series; ration including kudzu leaf meal, no milk.

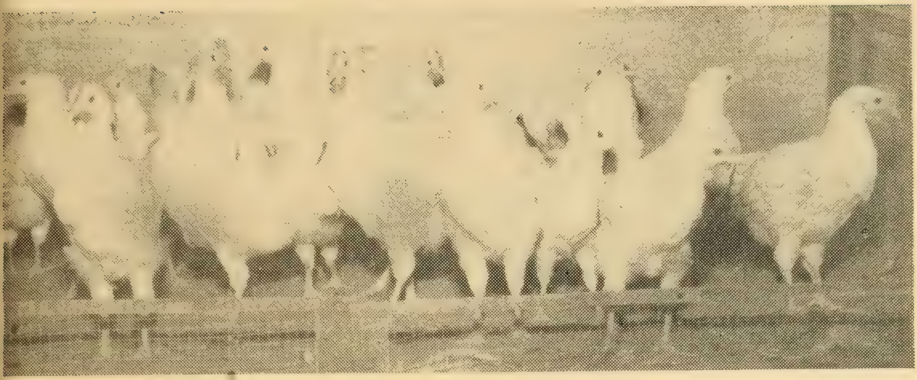

Figure 1C. Lot 3, Early Winter, 1944 Series; ration including kudzu meal and dried milk.

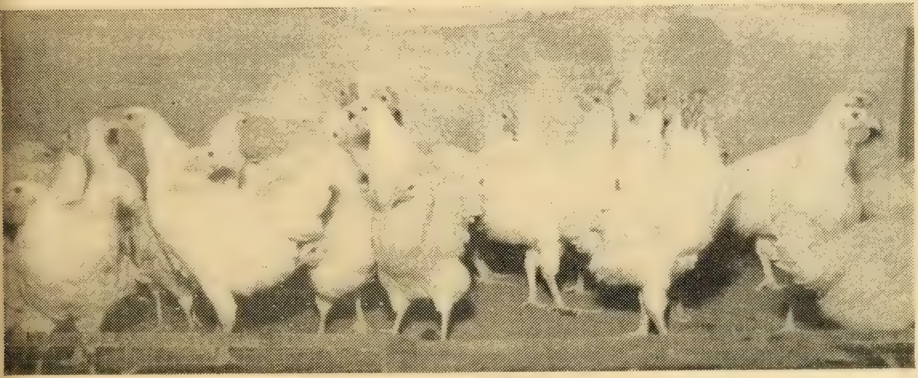

Figure 1D. Lot 4, Early Winter, 1944 Series; ration including kudzu meal, no milk.

Figure 1. Approximately one-half of the birds at the close of the November 27-December 29, 1944, feeding test. Little differences between lots is apparent, indicating that the rations containing kudzu were approximately as good as the ration containing alfalfa.

Series 1: Early Winter Feeding Period, November 27, 1943 to January 29, 1944

Table 3 gives the results secured for the first series of the experiment. Mortality during the first series of this experiment did not exceed 10 percent. The mortality was due to weak chicks and in most cases occurred during the first 2 weeks of the experiment. The chicks that died later were weak and did not gain at a normal rate of growth up to the time of their death. The chicks did not exhibit definite symptoms of vitamin A or vitamin B_2 deficiencies, even though the chicks in lot 2 depended on the kudzu leaf meal and chicks in lot 4 depended on the kudzu meal to bring the ration up to the minimum requirements for normal growth. Both of these rations were void of milk.

There is not an outstanding difference existing in weight between lot 1 and lot 3 chicks for either males or females. Lot 2 and lot 4 are very close in weight of males and females. It should be noted that lot 2 has an unequal distribution of

Table 3. Results of early winter feeding test of kudzu products used in starting rations for chicks, November 27, 1943 to January 29, 1944

	Lot 1	Lot 2	Lot 3	Lot 4
	Alfalfa meal with milk	Kudzu leaf meal without milk	Kudzu meal with milk	Kudzu meal without milk
Number chicks started	40	40	40	40
Percent mortality	2.5	5.0	10.0	2.5
Number males	18	10	18	26
Number females	21	28	18	13
Average weight males, ozs.	33.65	30.63	33.23	30.17
Average weight females, ozs.	28.20	27.79	27.40	27.27
Average weight all sexes, ozs.	30.77	28.54	30.32	29.21
Feed consumed per bird, lbs.	6.13	5.63	6.02	6.05
Feed per pound of gain, lbs.	3.19	3.10	3.12	3.64
Grades of birds at end of test:				
A	0	2	1	1
B	18	20	19	17
C	21	16	16	21
Rejects	0	0	0	0

sexes, in that there are 18 more females than males. This difference in sex ratio has influenced the final average in weight for this lot. The chicks in lot 4 were low for all lots even though the ratio of males to females was high.

Chicks fed the control ration were heavier by an average of 2.23 ounces than chicks on the kudzu leaf meal ration, 0.45 ounce heavier than chicks fed the kudzu meal and dried milk ration, and 1.56 ounces heavier than chicks fed the kudzu meal without milk ration, when averages for all sexes are considered.

There is very little difference in feed consumed per bird or in feed required to produce a pound of gain. Lot 2 was low in total feed eaten by each bird, and lot 1 was high; however, the difference was only 0.50 pound. Feed required to produce one pound of gain was low for kudzu leaf meal ration, being 3.10 pounds, and high for the kudzu meal and no milk ration, being 3.64 pounds.

All of the birds in each of the lots of this series of the test were well pigmented. Only a small percentage of the chicks graded A, and the remaining grades were well divided between grade B and grade C.

Table 4. Results of summer feeding test of kudzu products used in starting rations for chicks, May 26 to July 20, 1944.

	Lot 1	Lot 2	Lot 3	Lot 4
	Alfalfa meal with milk	Kudzu leaf meal without milk	Kudzu meal with milk	Kudzu meal without milk
Number of chicks started	40	40	40	40
Percent mortality	2.5	0	2.5	5.0
Number males	21	20	17	20
Number females	18	20	22	18
Average weight males, ozs.	28.39	26.86	27.40	27.65
Average weight females, ozs.	23.03	22.41	22.80	21.99
Average weight all sexes, ozs.	25.92	24.64	24.80	24.97
Feed consumed per bird, lbs.	4.83	4.87	4.88	4.93
Feed per pound of gain, lbs.	2.98	3.16	3.08	3.16
Grades of birds at end of test:				
A	1	0	0	1
B	8	12	10	20
C	30	28	29	16
Rejects	0	0	0	1

Series 2: Summer Feeding Period, May 26 To July 20, 1944

Mortality in the second series of this test, did not go above 5 percent, and then only in lot 4 where kudzu meal without milk was fed. As in the case of the first series of the experiment, mortality was due to weak chicks.

The ratio of males to females in the summer series of tests was well equalized. As to be expected, the weights for all lots were significantly lower than the first series fed the same rations during the winter months. This was due to hot weather, which is unfavorable to chick growth. The males and females were slightly heavier in the control ration lot than in the kudzu lots. There is no significant difference existing in weights of males or females for the kudzu meal ration plus 3 percent milk, the kudzu leaf meal ration without milk, and the kudzu meal ration without milk.

During the summer test, there was little difference between lots in total feed consumed per bird and in the feed required to produce a pound of gain.

It should be noted that the birds during the summer test ate less feed than

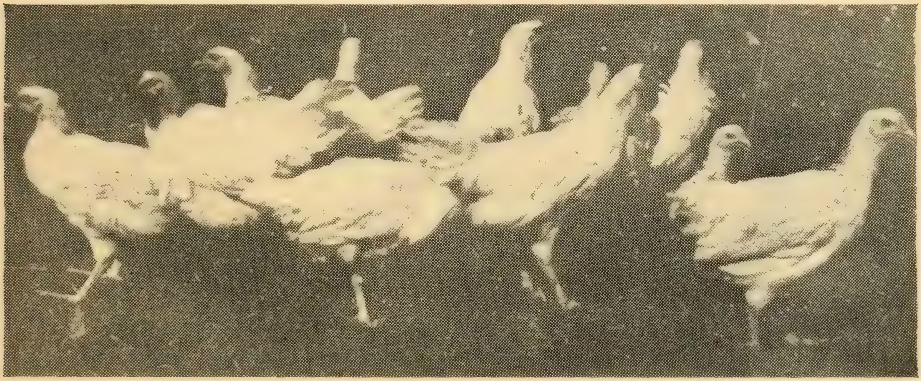

Figure 2A. Lot 1, Summer, 1944 Series; ration including alfalfa meal and dried milk.

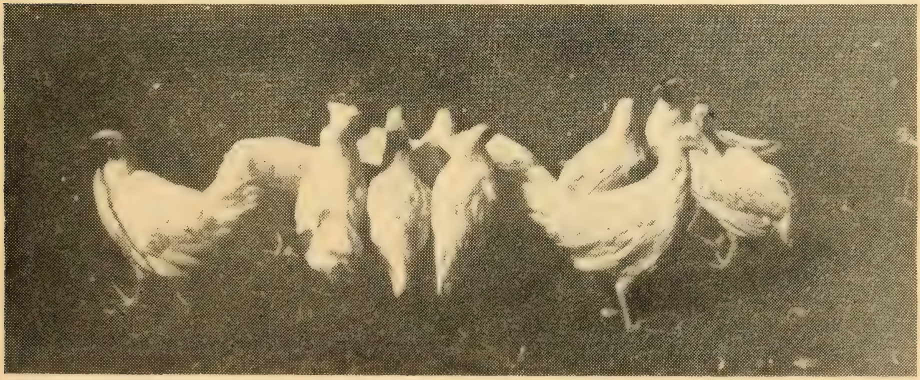

Figure 2B. Lot 2, Summer, 1944 Series; ration including kudzu leaf meal, no milk.

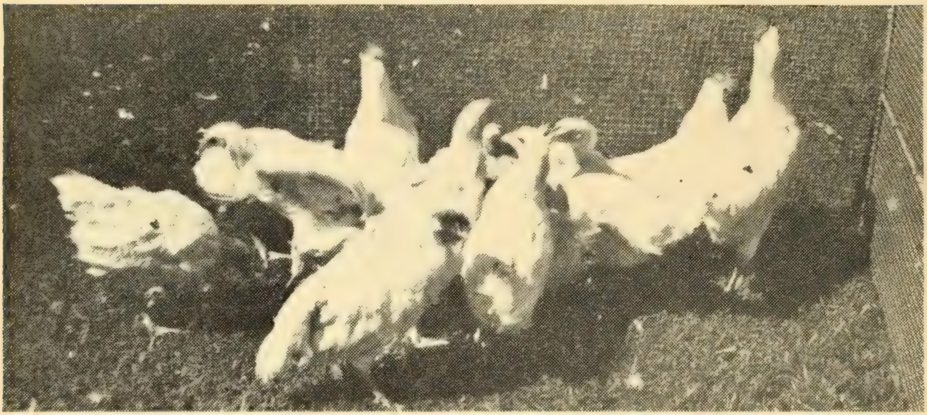

Figure 2C. Lot 3, Summer, 1944 Series; ration including kudzu meal and dried milk.

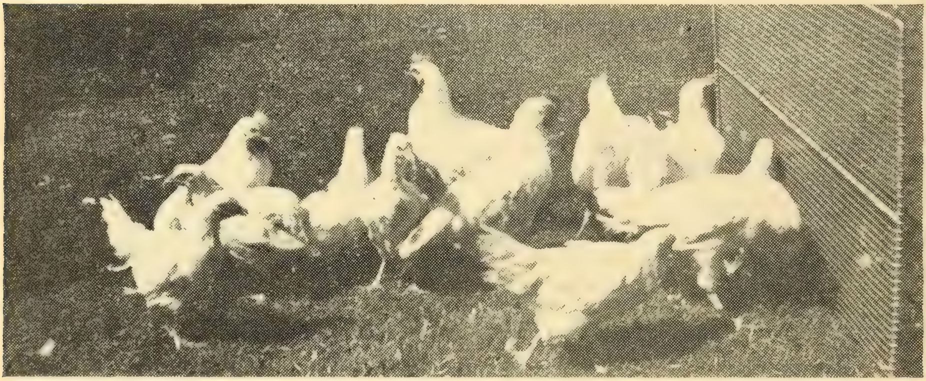

Figure 2D. Lot 4, Summer, 1944 Series; ration including kudzu meal, no milk.

Figure 2. Average males and females at the close of the May 26-July 20, 1944, feeding test. Although birds in all of the four lots of the summer series were inferior to birds produced in the early winter and late winter series, differences between the alfalfa ration and the kudzu ration chicks were small.

those during the winter months, though the cost per pound of gain is higher than series 1 or series 3. See table 4.

It is interesting to note that the majority of the birds completing the summer series of this experiment were graded C, with the exception of lot 4 which was equally divided between B and C. These chicks were well colored, but lacked finish and covering of the breast bone.

Series 3: Late Winter Feeding Period, December 12, 1944 To February 15, 1945

Table 5 presents a summary of the results for the third series of this test. Mortality in lots 3 and 4 was high with 5 percent each; one chick in lot 4, reported as mortality, disappeared between the second and third week of the test. The

Table 5. Results of late winter test of kudzu products used in starting rations for chicks, December 14, 1944 to February 15, 1945.

	Lot 1	Lot 2	Lot 3	Lot 4
	Alfalfa meal with milk	Kudzu leaf meal without milk	Kudzu meal with milk	Kudzu meal without milk
Number chicks started	40	40	40	40
Percent mortality	2.5	0	5.0	5.0
Number males	16	15	21	25
Number females	23	25	17	13
Average weight males, ozs.	35.56	33.97	34.58	31.90
Average weight females, ozs.	29.35	29.93	29.09	28.56
Average weight all sexes, ozs.	31.89	31.44	32.15	30.76
Feed consumed per bird, lbs.	6.38	6.43	6.77	6.24
Feed per pound of gain, lbs.	3.06	3.26	3.31	3.25
Grades of birds at end of test:				
A	3	8	1	0
B	18	25	20	24
C	18	7	17	14
Rejects	0	0	0	0

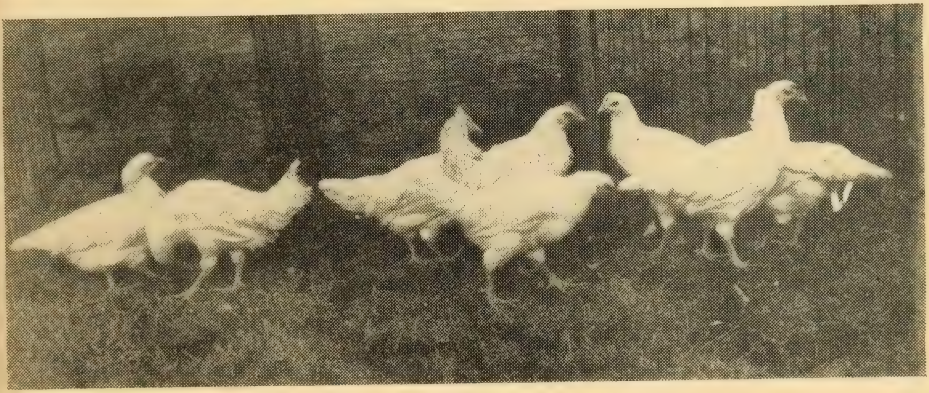

Figure 3A. Lot 1, Late Winter, 1945 Series; ration including alfalfa meal and dried milk.

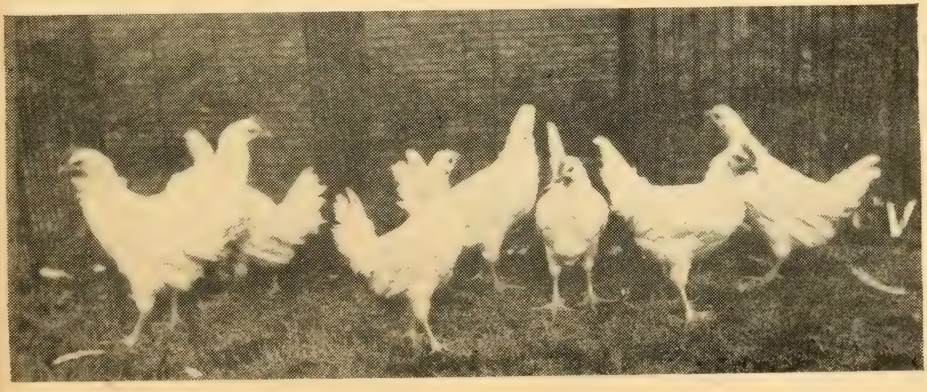

Figure 3B. Lot 2, Late Winter, 1945 Series; ration including kudzu leaf meal, no milk.

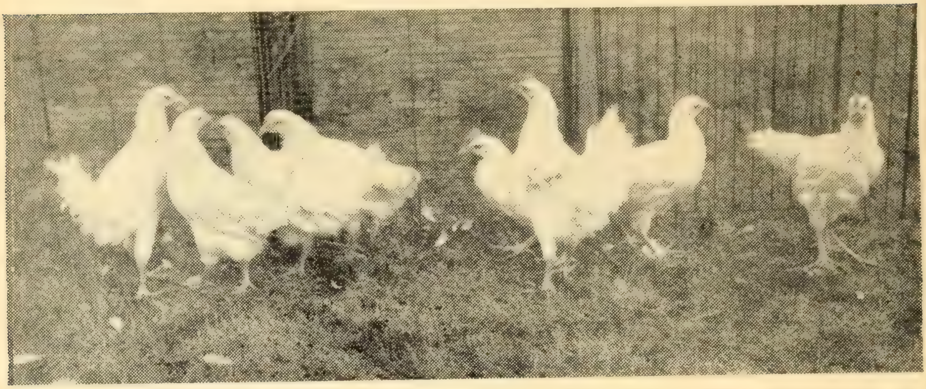

Figure 3C. Lot 3, Late Winter, 1945 Series; ration including kudzu meal and dried milk.

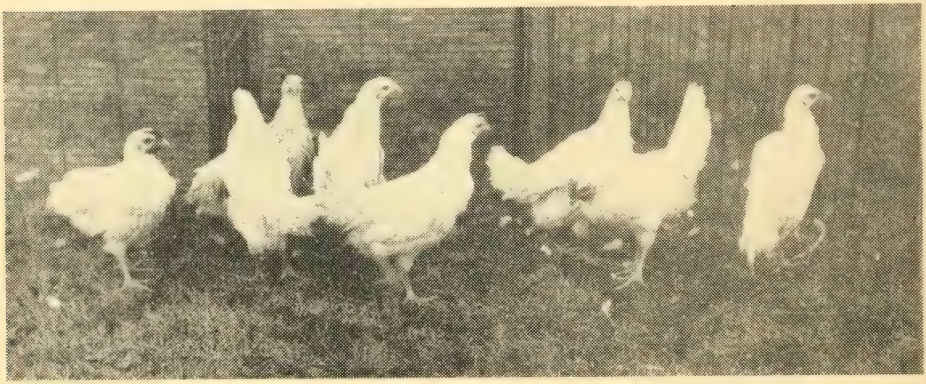

Figure 3D. Lot 4, Late Winter, 1945 Series; ration including kudzu meal, no milk.

Figure 3. Average males and females at the close of the December 12, 1944-February 11, 1945, feeding test. These were the best birds produced in the three feeding series, but, as in the case of the early winter and summer series, one ration appeared to be about as good as another.

mortality was due to weak chicks which died prior to the fourth week of the test.

The ratio of males and females was unequal in the kudzu leaf meal ration, there being 10 more females than males; and there were 12 more males than females in the kudzu meal ration without dried milk. Considering that males are usually heavier than females, an equalization of the sexes should increase the average weight of lot 2 and decrease the average weight of lot 4.

All weights of birds by rations were slightly heavier in this series of the test than for the first series conducted under similar climatic conditions. The chicks on the kudzu meal and 3 percent milk ration led all other lots with an average weight at 9 weeks of 32.15 ounces. Relatively slight differences between chicks on alfalfa meal, kudzu leaf meal, and kudzu meal with milk are apparent in average weights. The chicks on the kudzu meal ration without dried milk were low in weight, with an average weight of 30.76 ounces.

From the standpoint of feed required to produce 1 pound of gain, the alfalfa meal ration was low for this series with 3.06 pounds of feed required to produce 1 pound of gain. The greatest difference occurred when the alfalfa meal ration with milk and the kudzu meal ration with milk was used, this difference being 0.25 pound. The difference in the amounts of feed consumed per pound of gain in rations 2, 3, and 4 is not significant. These results indicate that alfalfa is slightly superior to kudzu in feed required to produce one pound of gain.

The kudzu leaf meal ration produced a higher percentage of grade A and grade B chicks than the other rations. There was not enough difference in grades between the alfalfa plus dried milk, kudzu meal plus dried milk, and kudzu meal without milk, to be significant. All rations produced chicks that were well pigmented, as was the case in series one and two.

Discussion

A summary of all series of this experiment is presented in table 6. The mortality did not exceed 5.83 percent for all rations used in this experiment. The principal cause of mortality was weak chicks, and such weak chicks in most cases died prior to the fourth week of the test.

Alfalfa meal and kudzu meal rations, both with the addition of 3 percent dried milk, produced chicks which varied in final average weight by one-half ounce. There was a difference of only one-tenth of an ounce between the kudzu leaf meal ration and the kudzu meal ration void of dried milk. Statistically, there is no significant difference existing in weight between chicks fed on rations containing alfalfa meal 9 percent plus milk, kudzu leaf meal 9 percent less dried milk, kudzu meal 9 percent plus dried milk, and kudzu meal 10 percent less dried milk. The kudzu leaf meal ration was at a disadvantage since there were more females than males which averaged lighter. This was reversed in the kudzu meal ration without dried milk, where there were more males than females.

Feed required to produce 1 pound of gain was low in the ration carrying 9 percent alfalfa meal plus dried milk, being 3.10 pounds; and high in the ration carrying 10 percent kudzu meal without dried milk, the feed requirement being 3.30 pounds. The difference existing between rations 2, 3, and 4 is very close. These results indicate that alfalfa dehydrated is slightly more efficient than the kudzu leaf meal or kudzu meal with or without dried milk.

From the standpoint of pigment, health, feathering, and grades, the kudzu leaf

Table 6. Average results of three series of tests of kudzu products used in starting rations for chicks, 1944-1945.

	Lot 1	Lot 2	Lot 3	Lot 4
	Alfalfa meal with milk	Kudzu leaf meal without milk	Kudzu meal with milk	Kudzu meal without milk
Number chicks started	120	120	120	120
Average percent mortality	2.5	1.7	5.8	4.2
Number males	55	45	56	71
Number females	62	73	57	44
Average weight males, ozs.	32.20	30.07	31.97	30.07
Average weight females, ozs.	27.16	27.05	26.13	25.49
Average weight all sexes, ozs.	29.53	28.20	29.02	28.31
Feed consumed per bird, lbs.	5.78	5.64	5.89	5.74
Feed per pound of gain, lbs.	3.10	3.20	3.25	3.30
Grades of birds at end of test;				
A	4	10	2	2
B	44	57	49	61
C	69	51	52	51
Rejects	0	0	0	1

meal, kudzu meal with dried milk, and kudzu meal without dried milk rations showed no apparent difference.

Throughout all series of this test no trouble was encountered from feather picking or cannibalism.

Conclusions

To supply an existing need for an ingredient in chick starter rations equivalent to alfalfa, which may be produced on or near most poultry farms in areas of Mississippi not adapted to alfalfa, the Poultry Department of the Mississippi Station conducted a series of tests with kudzu. Included in the study were chemical analyses, methods of harvesting and curing, and the feeding of three lots of chicks in early winter, late winter and summer series.

It was found that kudzu harvested by conventional farm methods yields hay and feeds of desired quality if exposure to the sun is short after cutting and the drying completed under shade. The method of drying is thought practicable for poultry producers; the hand-stripping method of securing leaves for kudzu leaf meal was for experimental purposes only.

Kudzu meal (ground kudzu hay) and kudzu leaf meal (ground air-dried kudzu leaves) compare favorably in chemical analyses with alfalfa meal and alfalfa leaf meal of good grade; these alfalfa products are accepted as standards of quality in the poultry feed industry.

Kudzu leaf meal dried by the process described in this experiment averaged 5,289.97 micrograms of riboflavin in 1 pound of feed and 128.96 micrograms of carotene in 1 gram of feed. Kudzu meal averaged 3,413.21 micrograms of riboflavin in 1 pound and 81.58 micrograms of carotene in 1 gram.

Ration 1, including alfalfa at the rate of 9 percent plus 3 percent dried milk, produced chicks which averaged 29.53 ounces; ration 2, including kudzu leaf meal without dried milk, produced chicks which averaged 28.20 ounces; ration 3, including kudzu meal with 3 percent dried milk, produced chicks which averaged 29.02 ounces; and ration 4, including kudzu meal without milk, produced chicks which averaged 28.31 ounces.

Statistically, there is no significant difference in the final average weights of chicks grown in batteries up to 9 weeks of age when fed alfalfa meal, kudzu meal, or kudzu leaf meal at the rate of 9 percent.

Under the conditions of this experiment, kudzu products compared favorably to alfalfa meal from the standpoint of average chick weights, mortality, grade, and feed required to produce one pound of gain.

There was no apparent difference in health, pigment, feathering, and grades of chicks produced by the four rations tested.

Acknowledgment

Acknowledgments are made to Miss Laverne McWhirter, Home Economics Department, Mississippi Experiment Station, and to Walter J. Peterson, head of Nutrition Section, North Carolina State College, Raleigh, for making determinations of riboflavin; and to Dr. C. D. Smith, Mathematics Department, Mississippi State College, for statistical work.

BULLETIN 415 MAY 1945

Changing Pattern of Food Preparation of Small Town Families in Mississippi

By

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CHANGING PATTERN OF FOOD PREPARATION OF SMALL TOWN FAMILIES IN MISSISSIPPI

By DOROTHY DICKINS*

Little is known about how foods are prepared in homes of representative groups of families composing our population, what changes are taking place in food preparation, and what leads to these changes. This is the first of a series of reports dealing with these important questions.

Food preparation is important, for better methods of food preparation are one way of improving family living that is not dependent on an increase in income. Yet to change food preparation may be even more difficult than to increase income, for food preparation is a part of one's culture. Food preparation methods are the result of one's environment, past, as well as present.

It is the purpose of this report to examine some of the changes that are taking place in food preparation of small town families of Mississippi, the factors underlying these changes and the implications of these changes and factors.

Scope of the Study

All eligible families in four small towns—two in each of two soil areas, Tunica and Marks of the Delta Area, and Eupora and Ackerman of the Short Leaf Pine Area—were included in this study. At the time of visiting the families in the summer of 1943, there were 1,426 families residing in these four towns. This number was slightly under an estimate which had been made from the 1940 census. However, none of these towns were in defense areas and in all cases more families had left than had moved in since 1940.

Data were obtained by personal interview with the homemaker, with the use of a schedule. White and Negro home economics teachers did the interviewing for the most part, more than 95 percent of these schedules being filled in by them. All of the Negro families were interviewed by the Negro teachers.

One hundred and ninety-two, or a little over 13 percent, of the families were ineligible for the study; that is, either ate meals away from home or had more than one boarder or had no female homemaker. Of those eligible families, schedules were obtained for 94.2 percent, or 1,158. This included 698 white families and 450 Negro families (see table a in Appendix). Housekeeping women living alone were counted as families.

DESCRIPTION OF FAMILIES

Size and Schooling of Members

The median size of white and Negro families was the same—three members (table 1). Homemakers and male heads in white families were, however, somewhat older than those in Negro families, median age of the former group being 45 and 48 years, of the latter group 38 and 40 years.

Median grade completed by both white homemakers and male heads was 12 grades. Median grade completed by Negro homemakers was 6 grades, by

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*The author wishes to express appreciation to Dr. Margaret Mead, Executive Secretary of the Committee on Food Habits of the Division of Anthropology and Psychology of the National Research Council, for reading the manuscript and offering many helpful suggestions; also to the homemakers whose cooperation made this study possible.

Negro male heads, 4 grades (table 1). Twenty-nine percent of the white homemakers had had college training. Three percent of the Negro homemakers had had college training.

Sixty-four percent of the white homemakers and 86 percent of the Negro homemakers were farm reared. The Delta white homemaker had more often had an urban background than had the Short Leaf Pine white homemaker. A number of Delta white families had moved from towns in other areas of the State. The reverse was the case with Negro homemakers. Ninety percent of those in the Delta Area and only 82 percent in the Short Leaf Pine Area were farm reared.

Food and Nutrition Background

In 54 percent of the white families and in 18 percent of the Negro families, there was one woman or girl, or more, with training in foods and nutrition received in public school, college, agricultural extension clubs and/or from other educational sources. The majority with such training had received it in public school. The training received was for the most part of short duration and very elementary. A few homemakers had had training in foods and nutrition at college—38 white homemakers and 11 Negro homemakers.

More families had food and nutrition reading material than had members who had taken training in foods and nutrition. Only 5 percent of the white families were without some reading material of this type. Fifty-seven percent of the Negro families were without it.

The most common kind of food and nutrition reading material owned by all groups was leaflets and booklets (table 2). Such leaflets consisted for the most part of advertising material (table c in Appendix), and included recipe booklets that came with the pressure cooker, the electric or gas range, the electric refrigerator, glass jars, as well as those advertising specific brands of foods.

Table 1. Median size of family, median years of age of male heads and homemakers and median grades completed by male heads and homemakers in white and Negro families in four towns of Mississippi, 1943.

Item	White families	Negro families
Size of family	3	3
Years of age:		
Of male heads	48	40
Of homemakers	45	38
Grades completed:		
By male heads	12	4
By homemakers	12	6

Table 2. Proportion of white and Negro families owning food and nutrition reading material of various kinds.

Kind of reading material	White families	Negro families
	Percent	Percent
Food and nutrition books	55	5
Clippings of good recipes	68	24
Food and nutrition leaflets or booklets	80	37
Magazines with a food and/or nutrition section	78	7
Number of families	698	460

Magazines were next in importance for white families, clippings of good recipes from miscellaneous sources for Negro families. Books dealing with food and nutrition were owned by fewer families in all groups than was any other type of nutrition material. Only 5 percent of the Negro families owned food and/or nutrition books. Most of the books owned were recipe books commonly known as "cookbooks." The oldest book owned by a large number of families was the White House Cookbook. More women owned cookbooks compiled by women's magazines and/or church societies and women's clubs than any other type of cookbook. Nutrition books per se were rarely found and when found were in most cases textbooks used by a member of the family who had taken home economics in school or college. Table b in the Appendix contains a list of food and nutrition books owned by families in this study.

Seven hundred and ninety-six magazines with a food section were subscribed to by the 698 white families and 38 by the 460 Negro families. These magazines included for the most part women's magazines and farm magazines (table d in Appendix).

In addition to reading material owned and purchased by the family, there was quite a bit of borrowing of such material that went on, especially so of women's magazines. A few women borrowed regularly from a neighbor. This was particularly true of white women. Negro women were often given old magazines by their employers, but in most cases not regularly.[1/]

Another source of foods and nutrition reading material, but not included in the schedule, was from daily and weekly newspapers. It should probably have been included because when the homemaker was asked to list new dishes prepared during the year and source of suggestion, recipes from newspapers were mentioned, but not nearly so often as were recipes from magazines and cookbooks.

The situation as to ownership of a radio, one source of securing food and nutrition information, was not so different from that of ownership of reading material. Ninety-three percent of the whites and 47 percent of the Negroes had a radio.

Planning and Cooking Meals

Ninety-percent of the homemakers in white families, as well as in Negro families, planned the meals. A little less than one in ten cooks planned the meals for the family of her employer, but in a number of cases they helped with planning.[2/] Cooks who planned meals were either in homes in which the homemaker was gainfully employed or in which she knew little about planning meals, either because of limited experience or training, or because of lack of interest. Homemakers in the families included were, therefore, in the main responsible for the food supply of their families.

In white families, the homemaker did the main cooking in 75 percent of the homes, a cook in 20 percent, and others in 5 percent. Ninety percent

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[1/] A record was obtained only of those magazines borrowed regularly. The Negro woman was not usually asked to return the magazines borrowed, but nevertheless she was classified as borrowing if she did not subscribe for them.

[2/] Negro household help is usually called a cook, even though her duties may include cleaning and laundry, and even though the homemaker does the main cooking.

of the Negro homemakers did the cooking. Other family members did it in the remainder of homes. The other member of the family who sometimes did the main cooking was most often a daughter. This was true in all groups.

CLASSIFICATION OF FAMILIES

Information concerning the use and preparation of 12 foods (cornbread, biscuit, salt pork, beef, eggs, cooked cabbage, slaw, milk, canned tomatoes, oranges, canned string beans, and sweetpotatoes) was obtained from all families in the study. This information was summarized in tables, three methods of classifying families being tried: (1) by soil area and race (white or Negro); (2) by monthly rent or rental value of house in which resided and race (table e in Appendix); (3) by soil area, race, and monthly rent or rental value of house in which resided (table f in Appendix.[3]

The classification by occupation was not tried for there were too few families in some of the occupational groups to insure getting a sufficient number of cases to participate in the record study which would be the second phase of this study.

The number of Negroes who were business owners or in professional service, and in clerical service was, for example, too small (table 3). Then, those families classified as "Farmer" and "No occupation" would have had to be broken down into subgroups. These subgroups would have yielded too few families from which to draw a record sample. "Farmer" included plantation owners, small-scale farm owners, day laborers, and these could not be included in one socioeconomic category. Nor could well-to-do families living from investments and poverty stricken families on public relief—both groups with "No occupation"—be placed in the same category.

By Soil Area and Race

Use and preparation of the 12 foods in white and Negro families of the Delta and Short Leaf Pine towns showed great variation. For example, 74 percent of the Delta white families, 57 percent of the Short Leaf Pine white families, 46 percent of the Delta Negro families, and 35 percent of the Short

Table 3. Main occupation of white and Negro families.

Main occupation	White families	Negro families
	Percent	Percent
Business owner or professional service	25	4
Clerical service*	32	2
Wage earner**	26	76
Farmer	7	13
No occupation***	10	5
Total	100	100
Number of families	698	460

*Includes clerks, salesmen, commission men, managers.
**Unskilled, semi-skilled, and skilled wage work.
***Lived from income from property, pensions, relief, etc.

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[3] Incomes were not secured from families in this study, since to obtain family income is almost itself a research study, and there is a limit to the information a family should be asked to give.

Leaf Pine Negro families ordinarily used beef once a week or more.[4] Six percent of the Delta white families, 8 percent of the Short Leaf Pine white families, 26 percent of the Delta Negro families, and 37 percent of the Short Leaf Pine Negro families, cooked cabbage until it was pink or brown in appearance.

Further study of the data showed that the variations in towns of different soil areas were due in some part to differences in home-food-production programs of families in the two areas, but more to differences in socioeconomic status of families in these areas as indicated by differences in monthly rent or rental value of house or rooms in which resided.[5]

White and Negro families in the Short Leaf Pine towns produced somewhat more food for family consumption than did those in the Delta towns (table 4). This may be because more homemakers in white families of the Short Leaf Pine Area had been reared on farms than had homemakers in white families of the Delta. More homemakers in Negro families of Delta towns had been reared on farms than homemakers in Negro families of Short Leaf Pine towns, but Negro farmers in the Delta have in the past been mainly concerned with cotton production. Living on a Delta farm has not necessarily meant training in food production for home consumption as it often has in poorer soil areas, such as the Short Leaf Pine Area.

The main effect upon the use and preparation of the 12 foods listed of greater home production programs of Short Leaf Pine town families seemed to be the greater use of milk for drinking and in cooking (table f in Appendix).

As will be noted in table 5, the majority of white Delta families had monthly rent or rental values of $20.01 to $40.00, while the majority of white Short Leaf Pine families had values of $7.51 to $20.00. Forty-six percent of the Delta Negro families and 28 percent of the Short Leaf Pine Negro families had housing values of $7.51 to $20.00. The fact that families in Delta and Short Leaf towns differed so much in use and preparation of the 12 foods can, therefore, be correlated with differences in socioeconomic status of families in the two areas. Analyses showed that use and preparation of the 12 foods varied with housing value (table e in the Appendix).

Table 4. Proportion of Delta and Short Leaf Pine families producing foods for home consumption.

Item	White families		Negro families	
	Delta towns	Short Leaf Pine towns	Delta towns	Short Leaf Pine towns
	Percent	Percent	Percent	Percent
Produce vegetables	79	85	75	78
Produce fruit	7	20	0	2
Have one or more milk cows	12	46	9	26
Own poultry	40	57	50	57
Slaughter for home consumption:				
Hogs	15	26	13	24
Beef	5	2	0	0
Number of families	326	372	256	204

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[4] Data concerning use and preparation of rationed foods were obtained for the period before rationing went into effect.

[5] Based on rent or value unfurnished.

Table 5. Monthly rent or rental value* of house in which white and Negro families of Delta and Short Leaf Pine towns resided, Mississippi, 1943.

Monthly rent of rental value	White families		Negro families	
	Delta towns	Short Leaf Pine towns	Delta towns	Short Leaf Pine twons
	Percent	Percent	Percent	Percent
$ 7.50 and under	1	7	53	72
$ 7.51-$20.00	26	52	46	28
$20.01-$40.00	58	40	1**	0
Over $40.00	15	1	0	0
Total	100	100	100	100
Number of families	326	372	256	204

*Henceforth to be designated as housing value.

**There were two Negro families with monthly rent or rental value of over $20.00 a month. These two families are not included in tabulations which follow.

By Housing Value and Race

It was decided to classify the families in this study by housing values and race, even thought there were some differences in the use and preparation of the 12 foods which could be attributed to home production programs, more common in the Short Leaf Pine towns. To have classified both by housing and soil area would have meant reducing the number of housing groups. Reduction in number of housing groups was thought undesirable, since the relationship between use and preparation of the 12 foods and house value was significant. There would have been too few cases in a number of categories to classify both by housing value and soil area (tables e and f in the Appendix).

CHANGING FOOD PREPARATION PATTERN

Two methods of studying the changing pattern of food preparation of these white and Negro families will be used: (1) analyzing new dishes or recipes prepared during year past, family reactions to these dishes, and who suggested; (2) comparing food preparation in homemaker's own home and in her parental home; (a) most common method used in preparing or serving the 12 foods previously named in both homes, (b) most common methods of preparing fresh vegetables and fruits in both homes.

New Dishes Tried During Report Year

The first method of studying the changing pattern of food preparation was to get from the homemaker a list of new dishes served in the home during the previous year (1942-43), including new food preservation. This list does not include all new dishes served in homes of families of this study since some of the new dishes were not remembered by the homemakers and, therefor, were not reported. It does include, however, new dishes that were remembered. The fact that these new dishes were remembered would seem to mean that quite a change had been made. The new dishes reported included new foods as well as new combinations or ways of preparing old foods. Families keeping house for the first year were not eligible for this part of the study.

In table 6 is given the different types of new dishes tried by white and Negro homemakers by housing value groups. As may be noted, more new dessert dishes were tried than any other type of food. Vegetable dishes were next in importance, meat and meat alternates and salads took third and fourth places, respectively, in type of new dishes tried. Desserts were relatively more important in the low housing value groups; salads relatively more important in the higher housing value groups.

In spite of the fact that a record was obtained of only 47 new dishes from the $7.50 and under white group, a separate tabulation will be made of this group since even though the number of cases is small, the data are consistent, both inside the small sample and also as among other samples. It is an advantage to break the $20.00 and under housing value white groups up into two groups in order to compare with Negro families, all of whom had housing values of $20.00 and under, and the majority had values of $7.50 and under.

In table 7 is listed "who or what" suggested the new dish tried. It is possible that the idea for the new dish might have been "hatching" more or less for sometime in the mind of the homemaker and that the final influence that caused action—the one she probably mentioned—was not the most important. According to these homemakers, more new dishes they tried were suggested by their friends than by any one or anything else. This was true of Negro as well as of white families. It was true of families in the housing value group over $40.00 as well as in the housing value group of $7.50 and under.

The factor of next importance for new dishes tried was not so clear-cut. For the housing value group of $7.50 and under white families, it was "relatives;" for the two large groups of white families ($7.51 to $20.00 and $20.01 to $40.00) who had tried so many new dishes during the report year, it was "thinking it up." The source of suggestion second in importance for the highest value housing white group was recipes from magazines, newspapers, and cookbooks. "Seeing in a store or having clerk call attention to" was nearly as important.

Table 6. Type of new dishes tried in families during report year, classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number new dishes tried	47	806	1099	130	299	210
Food type	Percent of dishes tried	Percent of dishes tried	Percent of dishes tried	Percent of dishes tried	Percent of dishes tried	Percent of dishes tried
Vegetables	23	17	19	27	26	23
Salads	7	10	11	12	6	11
Fruits*	11	2	3	2	6	4
Desserts, including cakes	36	30	29	28	35	39
Meat, and meat alternates**	17	14	14	15	15	13
Breads and cereals	6	9	9	10	5	4
Home preservation	0	15	13	5	6	4
Other foods	0	2	2	1	1	2
Total number of families	32	277	338	51	283	175

*Fruit pies, puddings, cobblers, classified as desserts.

**Does not include beans and peas which are classified as vegetables. Does, however, include peanuts.

Table 7. Who or what suggested new dish tried in families during past year, classified by race and housing value of families.

Who or what suggested	White families Housing $7.50 and under	White families Housing $7.51-$20	White families Housing $20.01-$40	White families Housing over $40	Negro families Housing $7.50 and under	Negro families Housing $7.51-$20
Total number of new dishes tried	47	806	1099	130	299	210
	Percent	Percent	Percent	Percent	Percent	Percent
Friends	33	27	28	27	30	27
Family members	4	7	6	6	3	4
Relatives	13	10	5	5	11	10
Cook	0	*	1	7	0	0
Thought it up	9	17	17	11	6	9
Home economists	4	4	3	1	2	2
Agriculturists	0	*	*	0	1	1
Recipes from magazines, newspapers, cookbooks	6	11	14	15	6	12
Advertising material	15	14	11	7	11	15
Government and state agricultural bulletins or leaflets	4	*	1	1	0	0
Seeing in store or having clerk call attention to	6	8	12	14	4	5
Eating out	2	1	1	5	1	*
Physician	2	1	1	1	3	1
Public relief	2	0	0	0	2	0
White woman	0	0	0	0	20	14

*Less than 0.5 percent.

In the $7.50 and under Negro group, suggestions from a white woman ranked second. These suggestions took third place in the $7.51 to $20.00 Negro group, where advertising material was second in importance to friends as a source of suggestion for new dish tried. Many of the Negro homemakers included had worked for some time in the home of a white family, though at the time of the study they may not have been so engaged. Some had occasional jobs in homes of white families. Others cooked regularly in the home of a white family as well as for their own family. In fact, there were few Negro women in these towns who did not have, at the time of the study or had not had at sometime in the past, close contact with a white woman. All this would explain the relatively large proportion of suggestions for new dishes from white women.

The fact that Negroes were earning more at the time of this study, that some of them were receiving money from the government or from relatives working away from home may have made it more feasible than it generally is to try out a dish they had eaten or seen prepared in the home of a white family. To prepare food just like white people (the kind of white people Negro women usually come in contact with) takes money. Lack of cash to cook this way largely explains why Negro women who have worked for white people in town and who move back to the farm in the role of homemaker in a sharecropper family oftentimes show no evidences of their past food preparation experience.

The number of homemakers reporting that the new dish had been suggested by a home economist was relatively small (table 7). At the time of the study, home economics was taught in three of the four high schools for white children and in one Negro school, but when a daughter taking home economics prepared at home a new dish learned at school, or suggested to her mother that she prepare the dish, the source of suggestion to the homemaker was recorded as daughter and placed in the group "family member."

In all four towns there were Farm Security Administration home economists, but these women were employed to work with farm families who had borrowed from the Farm Security Administration. In two of the towns there were agricultural extension home agents for white families and in one town an agricultural extension home agent for Negro families. It was from these three home agents that most of the suggestions for new dishes tried given by home economists came.

Home economists were less often the source of the suggestion of new dishes tried in this study of town homemakers than in case of a somewhat similar study of rural homemakers[6] where "thought it up" and "home economists" were second only to "friends." The town homemaker has more contacts with other homemakers, more food and nutrition reading material and more radios than does the farm homemaker. She visits the grocery store much more often. Consequently, she would be more affected by these other factors than the rural homemaker. Also, she does not have home economists employed especially to assist her with homemaking problems, including food problems, as does the rural homemaker.

Even though the number of town homemakers reporting suggestions of new dishes tried coming from home economists was limited, the total effect of home economists on the food preparation pattern of these town homemakers was not limited. In the first place, many of the new dishes tried had been originated by home economists. Material in magazines, cookbooks, newspapers, and advertisements had often been prepared by home economists. Friends, relatives, and family members had in a number of cases received their suggestions from home economists, or from others who had received theirs from home economists.

Even though the actual number of suggestions acted on directly received from home economists was small, the quality of the suggestions acted on is quite significant. Relatively more of the suggestions given by friends and advertisements concerned new dessert dishes, while three-fourths of the suggestions listed as coming from home economists concerned new vegetable dishes or some new kind of food preserved for the family (in most cases vegetables).

The following are some of the vegetable dishes prepared for the first time for their families—suggestions for which came from home economists: Steamed mustard greens, string beans cooked for a short time and seasoned with butter, beet tops cooked a short time and served with butter and sliced eggs, bean loaf (as a meat alternate), dried soybeans cooked in a pressure cooker, cabbage cooked a short time in milk, buttered beets (the ordinary method is pickled), scalloped squash, and baked eggplant.

Vegetables most often canned for the first time, the suggestions coming directly from home economists, included those in the non-acid group; i.e., turnip greens, soup mixture, carrots, swiss chard, okra, and squash.

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[6] Food Preparation of Owner and Cropper Farm Families in the Short Leaf Pine Area of Mississippi, Dorothy Dickins, Social Forces, Vol. 22, No. 1, October 1943, pp. 62.

Some of the other dishes prepared at suggestions of home economists were: baked fish, apple and raw carrot salad, molasses custard, ginger bread prepared with sorghum sirup, creamed chicken, pumpkin pudding, pudding with cornmeal and sorghum sirup, beets in salad, wilted lettuce, boiled salad dressing, soybean muffins, cake using corn sirup instead of sugar, and canned meat. It will, therefore, be noted that home economists had not limited their demonstrations to vegetable dishes and vegetable canning. It is well, however, that they did emphasize vegetable preservation and cookery, for these small-town families could produce vegetables in their home gardens and thus help to conserve the national food supply. Then, too, a recent food consumption study shows that diets of small-town families contain less vitamin C and vitamin A than diets of farm and city families.[7/] Vegetables are rich in both vitamins, especially if they have been prepared, or are preserved, by methods such as home economists recommend.

Most of the homemakers reporting foods prepared at the suggestion of an agriculturist reported a vegetable dish and/or canned meat. Suggestions taken from government or state agricultural bulletins or leaflets included for the most part canned vegetables.

The source of suggestions varied considerably in families of the different housing value groups (table 7). In the higher housing value groups "thought it up," "family members," "cook," "recipes from magazines, newspapers, cookbooks," "seeing it in store or having clerk call attention to" were more important than in lower housing value groups. On the other hand, "relatives" (mother, sister-in-law, grand-mother, niece, brother, cousin, mother-in-law, aunt, etc.) and "advertising material" were more important for low housing value groups. Advertising material included leaflets, labels, radio, and advertisements in newspapers and magazines. Suggestions from leaflets were the most popular source of advertising material. Suggestions from labels ranked second.

The source of the suggestions for the dishes tried, as would be supposed, varied with type of food. This will be taken up later when types of foods tried are discussed.

The two big housing value groups of white families—those with housing values of $7.51 to $20.00 and those with housing values of $20.01 to $40.00—were the groups in which homemakers most frequently tried one or more new

Table 8. Proportion of families who tried one or more new dishes during past year, number per family tried, percent of total that were new foods classified by race and housing value of families.

Group: race and housing value	Percent of total families trying one or more new dishes	Av. number new dishes tried by those trying	Percent of total new dishes tried that were new foods
White families $7.50 and under	50	2.9	17
White families $7.51-$20.00	86	3.4	13
White families $20.01-$40.00	85	3.8	11
White families over $40.00	78	3.3	13
Negro families $7.50 and under	65	1.6	18
Negro families $7.51-$20.00	75	1.6	14

[7/] "Family Food Consumption in the U. S." U. S. Dept. of Agr. Misc. Pub. No. 550, pp. 131 (1944).

dishes and the groups averaging more new dishes tried per family (table 8). These are doubtless the groups in which a food preparation program could be more easily put over.

As previously mentioned, new dishes included dishes of two types: (1) those of familiar foods in new combinations; (2) those of new foods. Proportionally more of the new dishes tried by homemakers in the lowest housing value white and Negro groups were new foods, but the majority of new dishes tried by homemakers in all groups were new combinations of familiar foods. Eighty-seven percent of the 2,591 new dishes tried by the 1,156 families were new combinations of old foods. A change in brand was not regarded as a new dish.

Table 9 lists the type of new foods tried by the white and Negro homemakers during the report year (1942-43). As may be noted, new vegetables composed nearly two-thirds of the group of new foods tried. One reason for this is that there is a large number of vegetables that can be grown in Mississippi, and with the war and victory gardens some of the little known vegetables have been stressed. Some families may have associated trying new vegetables with helping in the war effort. Rationing of canned vegetables may have led some homemakers to try out a new kind of fresh vegetable. It is possible that local grocers offered a larger variety of vegetables due to rationing. Another consideration, and a no small one, is that the possibility of securing a new vegetable to try was, for the typical family of this study, greater than of securing a new meat or a new fruit. The new vegetables tried by the racial and housing value groups will be discussed in the section devoted to new vegetable dishes.

Next to new vegetables in importance were new salads (table 9). The fact that most new vegetables and/or new fruits are first tried as a new vegetable dish or a new fruit dish, not in salad, would account for the small number of new salads listed. New salads, fruits, bakery products, meats and meat alternates, will be discussed in later sections of this report.

Fifteen families reported that they had tried margarine for the first time during the report year (table 9). The fact that there is a prestige attached to the use of butter may account in part for no greater number reporting. On the other hand, pork fat is used quite extensively. A number of families owned milk cows, especially in the Short Leaf Pine Areas. There was country butter available. Then, too, there were some grocers in these towns who did not handle margarine, as they were unwilling to pay the federal tax to handle it. This study covered a period when butter was not scarce in Mississippi, though requiring ration points.

Table 9. Type of new foods tried in white and Negro families during 1942-43.

Type of new food	Number of foods
Vegetables	204
Salads	26
Fruits	22
Bakery products	18
Meats and meat alternates	17
Margarine	15
Drinks	10
All other	22
Total	334

New drinks included, for the most part, coffee substitutes purchased because of coffee rationing. Homemade breads and desserts in which new foods; i.e., soybean flour, pumpkin, were used were classified in the "all other" group of new foods tried (table 9).

The family reaction to 136 (or 5 percent) of the new dishes tried was rated as poor or fair by the homemaker. Eighteen percent of the new foods tried were rated as poor or fair, but only 3 percent of the new combinations of familiar foods were thus rated. In other words, the family was six times more apt to like a new combination of familiar foods than a new food. Detailed information concerning dishes tried that were disliked will be discussed in the sections pertaining to particular types of food.

It is interesting to see that family members gave good response to the vast majority of new dishes tried (table 10). This no doubt means that new dishes are not, as a rule, tried unless the homemaker is fairly sure her family will like the food. There was a tendency for the lowest and highest housing value families to rate as poor or fair more new dishes. In low housing value groups proportionally more new dishes tried were also new foods, and new foods are less likely to be favorably received by the family. Why more foods tried in the over $40.00 white group met with unfavorable reception may have been that because of higher incomes these families could better afford to try out doubtful dishes, or it may be that family members in this group are more difficult to please. Then, too, the fact that the number of cases was limited may have been a factor.

Of the 136 foods rated by family members as poor or fair, 75, or 55 percent, were vegetable dishes. Vegetable dishes constituted 20 percent of the new dishes tried. This, of course, means that vegetable dishes received proportionally more than their share of low ratings by the family. The fact that new vegetable dishes included a relatively large proportion of new vegetables may account in part for the low ratings given. Family members are not as likely to rate new foods as good or excellent, as they are new combinations of old foods.

Another factor was undoubtedly poor preparation. If, for instance, the new vegetable dish was not well prepared, family members may have put it in the fair or poor category, when if well prepared it would have received a good or excellent rating. The main part of this study concerns methods of preparing foods by a representative group of these 1,158 homemakers. Meth-

Table 10. Total number of new dishes that were tried, number and percent of those that were tried, rated as poor or fair, number of new foods that were rated poor or fair, classified by race and housing value of families trying them.

Group: race and housing value	Total new dishes tried	Total new dishes rated poor or fair	Proportion new dishes tried rated poor or fair	New foods that were rated poor or fair
	Number	Number	Percent	Number
White families $7.50 and under	47	4	8.7	2
White families $7.51-$20.00	806	37	4.6	16
White families $20.01-$40.00	1099	48	4.5	20
White families over $40.00	130	13	10.0	6
Negro families $7.50 and under	299	23	7.7	12
Negro families $7.51-$20.00	210	11	5.2	5
Total	2591	136	5.2	61

ods of preparing vegetables in use by some of these women left much to be desired.

New breads, cereals, and drinks were other foods in which there were a number of fair and poor ratings given by family members. Here, too, there were many new foods—a new kind of grain, a whole-grained product when only the refined product had been used, coffee substitutes that were almost invariably disliked. All this points to food preparation programs with emphasis based on new combinations of familiar foods. It also shows need for further development of techniques in introducing new foods.

Women in all age groups tried new dishes during the report year, but as is shown in table 11, both white and Negro women under 60 years were more likely to try out a new dish than those 60 years and over. Especially was this the case of families in which there were no younger members. One stimulus for trying out something new is a daughter or son to approve. "What's the pleasure," asked one homemaker, "in trying out a new recipe when there's only me and a husband who likes what he's used to?"

There was no difference in the amount of schooling of the white homemakers who tried one or more new dishes during the report year and those who did not try a new dish during this period. However, Negro homemakers trying one or more new dishes averaged 2 years more schooling than those who had tried no new dishes. The average number of grades completed by those who had not tried a new dish was five grades; by those who had, seven grades.

Desserts. As has been noted, homemakers in all groups reported more new dessert dishes than any other kind of new dish. It is thought that one of the principal reasons for the large number of new desserts tried was sugar rationing, since many of the new desserts were familiar recipes substituting corn sirup, molasses, marshmallows, or honey for sugar; vanilla wafer crumbs for bread crumbs. Other desserts tried, by using condensed milk or a mix, saved sugar as well as time. It is doubtful if the popularity of desserts from condensed milk and mixes can be laid entirely on the war and rationing, since they do save time. War and rationing have no doubt speeded up certain changes that would have come anyway, as well as brought changes that would otherwise not have occurred.

Only 15 of the 803 new desserts tried were rated as poor or fair. Six of these desserts were made from mixes (when formerly the dessert had been mixed in the home). In eight, corn sirup or marshmallows had been substituted for sugar. One used a new fruit—pumpkin—that was not liked.

Table 11. Proportion of families who tried one or more new dishes during past year classified by race and age of homemaker.

Group: race and age of homemaker	Percent of families in which one or more new dishes were tried
White families:	
Homemaker under 60 years	86.2
Homemaker 60 years and over	70.8
Homemaker 60 years and over—no younger people in family	57.3
Negro families:	
Homemaker under 60 years	69.2
Homemaker 60 years and over	42.6
Homemaker 60 years and over—no younger people in family	31.3

One explanation, of course, for the favorable reaction of the family to new desserts was the fact that most of the new desserts were new combinations of familiar foods. As previously mentioned, homemakers rarely introduced new fruits to their families in the form of puddings or pies. Only four desserts tried during the year contained fruits unfamiliar to the family. The fruits were pumpkin, boysenberry, rhubarb, and cherry.

In table 12 is given the types of desserts tried in the six groups of families. As may be noted, Negro homemakers tried relatively more kinds of "pies, cobblers, shortcakes" than did white families. This was in part because of the popularity in these groups of condensed milk pies; also because of the fact that the Negro homemaker was somewhat more likely to use a pudding mix in a pie than was the white homemaker.

As would be expected, higher housing value groups more often tried new ice creams than did lower housing value groups. They much more frequently owned electric refrigerators in which ice cream can be made with an expenditure of minimum energy. Rationing of sugar and limitations on the sale of cream involved changing ice cream recipes.

The main trend in new desserts tried was an increase in the use of fruit desserts: new combinations of fruits and gelatin; fruits in custards, in whips, in puddings; fruits in upside down cakes; fruit juices of all kinds in meringue pies; prune pies, raisin pies; fruits in pies and shortcakes. Stewed or baked fruits were classified in this study as "fruits" and will be discussed under this heading, although they, too, may be regarded as desserts.

Advertising material was the most important source of suggestions for new dessert dishes in the $7.51 to $20.00 Negro group; in all other groups friends was the most important source (table 13). Advertising material was

Table 12. Type of new desserts tried in families during past year classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new desserts tried	17	245	319	37	104	81
Type of dessert	Percent	Percent	Percent	Percent	Percent	Percent
Cakes and fillings	12	12	13	24	20	19
Cookies	24	9	5	0	3	3
Ice creams	6	19	28	24	9	6
Pies, cobblers, shortcakes	29	30	28	30	56	60
Puddings (including fruit whips and gelatin dishes)	29	30	25	22	12	12
Candies	0	0	1	0	0	0
Proportion of new desserts in which mixes were used	6	9	20	19	11	5
Proportion of new desserts that involved sugar substitutes or extenders	18	43	53	38	31	36
Proportion of new desserts that involved fat substitutes or extenders	6	2	1	3	0	1

Table 13. **Who or what suggested new desserts tried in families during past year classified by race and housing value of families.**

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new desserts tried	17	245	319	37	104	81
Who or what suggested:	Percent	Percent	Percent	Percent	Percent	Percent
Friends	29	26	29	25	34	27
Relatives	12	7	6	5	11	9
Thought it up	18	18	19	14	7	3
Advertising material	23	15	12	5	21	35
Home economists	0	2	1	0	0	1
Recipes from magazines, newspapers, cookbooks	6	18	17	19	6	11
Eating out	6	1	*	0	1	0
Seeing in store or having clerk call attention to	6	9	14	16	4	5
Family members	0	4	2	8	3	2
Physician	0	*	0	0	0	0
Cook	0	0	0	8	0	0
White woman	—	—	—	—	13	7

*Less than 0.5 percent.

second to friends in importance in the lowest housing value white and Negro groups.

Recipes from magazines, newspapers, and cookbooks was an important source for new desserts tried by the three larger groups of white families, though "thought up" was as important for the $7.51 to $20.00 and the $20.01 to $40.00 groups as were recipes from these sources. Homemakers in these two groups tried out more new dishes than did those in the other four groups. Many of these women enjoyed cooking for their families. Some mentioned enjoying "experimenting with foods." Many of their faces lighted up when telling of the new dishes they had prepared and just how they had done it. Since nutrition investigators are making available from day to day results of studies on the conservation of food values in cooking, it is well that there is a great middle group of homemakers who enjoy trying out new dishes. Surely they can be used to better advantage in programs of food for health than they have been used in the past.

Vegetables. Five hundred and twenty-five new vegetable dishes were tried by the 1,156 families included in the six groups in which the families of this study are classified. About 40 percent of the 525 new dishes were vegetables that had not before been tried by the family; 60 percent were new ways of preparing familiar vegetables.

Thirty-five different kinds of vegetables, including a total of 204, were prepared for the first time (table 14). Spinach was the vegetable most frequently cooked for the first time. Carrots came next. Swiss chard, eggplant, cauliflower, and broccoli were also important new vegetables.

In the two $7.50 and under housing value groups of white and Negro families, carrots was the new vegetable most frequently tried. In the next two groups of white and Negro families with housing values of $7.51 to $20.00,

Table 14. New vegetables* prepared by families during past year classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new vegetables	4	63	73	13	31	20
New vegetables tried:	Number	Number	Number	Number	Number	Number
Spinach	0	14	8	0	4	3
Carrots	3	9	4	0	6	2
Swiss chard	0	7	11	1	3	1
Eggplant	0	3	6	1	6	1
Cauliflower	0	7	4	0	2	1
Broccoli	0	1	8	3	0	0
Beet tops	0	2	1	0	5	2
Brussels sprouts	0	1	5	0	0	2
Soybeans	1	2	5	0	0	0
Squash	0	2	4	0	0	0
Chinese cabbage	0	2	2	1	0	0
Parsnips	0	2	2	0	0	1
Purple cabbage	0	1	0	0	0	2
Fresh asparagus	0	0	3	0	0	0
Poke salad	0	1	0	0	1	2
Canned asparagus	0	4	0	0	1	1
Acorn squash	0	0	0	2	0	0
Carrot tops	0	0	0	0	1	1
Kale	0	0	2	0	0	0
Artichokes (globe)	0	0	1	1	0	0
Salsify	0	1	2	0	0	0
Kohlrabi	0	1	1	0	0	0
Collards	0	1	0	1	0	0
Chinese mustard	0	0	0	1	0	0
Chayote	0	0	0	1	0	0
Hubbard squash	0	0	0	1	0	0
Butter peas	0	0	1	0	0	0
Canned northern beans	0	0	0	0	1	0
Turnip greens	0	0	1	0	0	0
Dry black-eyed peas	0	0	1	0	0	0
Kraut	0	0	0	0	1	0
Radish tops	0	0	0	0	0	1
Okra	0	0	1	0	0	0
Wax string beans	0	1	0	0	0	0
Dry beans (pinto)	0	1	0	0	0	0

*New vegetables mean vegetables that were used for the first time by the family.

spinach was the most important. White homemakers in the $20.01 to $40.00 group tried spinach and broccoli for the first time about equally as often, while in the over $40.00 group, broccoli was the most important new vegetable.

The over $40.00 housing value group tried a few vegetables rather rarely used by Mississippi families: chayote, Hubbard squash, and globe artichokes. These vegetables are rare because they are not grown in the State and are not found in the markets of small towns.

In table 15 is listed vegetables that were rated as poor or fair by the families trying them. In this list is included those vegetables prepared in a new way as well as new vegetables. Of the new vegetable dishes prepared by as many as 10 homemakers, including 14 vegetables (carrots, summer squash, eggplant, spinach, cabbage, sweetpotatoes, Swiss chard, Irish potatoes, canned asparagus, cauliflower, corn, broccoli, string beans, beet tops), the three vegetable dishes receiving relatively more fair or poor ratings were cauliflower, spinach, and broccoli.

The fact that cauliflower and broccoli were often not broken up into sections, but the entire head cooked in one piece may account in part for the number giving these two vegetables poor ratings. It takes a shorter time to cook the section and strong flavor is less likely to be developed. This method of preparing cauliflower and broccoli was no doubt a result of unfamiliarity on the part of the homemaker with these vegetables and absence of recipes for preparation. New vegetables are not accompanied by leaflets and labels as are products of food manufacturers. In this respect, the farmer-producer is falling down on his job.

Table 15. New vegetable dishes* tried that were rated poor or fair by families classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total rated poor or fair	2	23	26	8	10	6
Vegetable:**	Number	Number	Number	Number	Number	Number
Spinach	0	6	2	0	3	0
Carrots	1	3	1	0	2	1
Cauliflower	0	2	3	0	1	0
Summer squash	0	2	3	1	0	0
Swiss chard	0	2	3	0	0	0
Soybeans	0	1	3	0	0	0
Broccoli	0	0	3	1	0	0
Eggplant	0	2	1	0	1	0
Chinese cabbage	0	1	1	1	0	0
Cabbage	0	1	2	0	0	0
Beet tops	0	0	0	0	1	0
Canned northern beans	0	0	0	0	1	0
English peas	0	0	0	0	1	0
Purple cabbage	0	0	0	0	0	1
Brussels sprouts	0	0	0	0	0	1
Beets	0	0	0	0	0	1
Radish tops	0	0	0	0	0	1
Poke salad	0	0	0	0	0	1
Sweetpotatoes	1	0	0	0	0	0
Acorn squash	0	0	0	1	0	0
Chinese mustard	0	0	0	1	0	0
Irish potatoes	0	0	0	1	0	0
Hubbard squash	0	0	0	1	0	0
Chayote	0	0	0	1	0	0
Canned asparagus	0	1	0	0	0	0
Collards	0	1	0	0	0	0
Fresh lima beans	0	1	0	0	0	0
Kohlrabi	0	0	1	0	0	0
Kale	0	0	1	0	0	0
String beans, green	0	0	1	0	0	0
Parsnips	0	0	1	0	0	0

*Includes new vegetables and new ways of preparing familiar vegetables.

**In case of a vegetable mixture, the main vegetable.

It might seem to the nutritionist a good idea to increase milk consumption by introducing more creamed vegetables, but a number of creamed vegetable dishes tried by families in this study received low rating. Especially was this the case of new vegetables creamed. If there must be some creaming, let it be on familiar vegetables as, for instance, Irish potatoes. Vegetables seem to be better taken by the average family seasoned with salt pork or bacon or drippings from same, though seasoning with butter or margarine seemed on the increase.

The so-called "quick frying" of vegetables was popular with the low housing value groups. By "quick frying" is meant cooking quickly in a covered skillet with a little water and fat. Vegetables cooked in a skillet are usually referred to as "fried" even though the amount of fat used may be small. Vegetables actually fried, such as eggplant and okra, were usually more acceptable when dipped in cornmeal before frying than when dipped in flour or a batter.

Among the vegetable dishes with low ratings were mixtures such as carrots and onions. Strange concoctions, recipes sometimes appearing in women's magazines, i. e., fresh lima beans with cheese sauce, did not, as a rule, find favor.

A new leafy vegetable, such as Swiss chard, spinach, beet tops, found better acceptance when cooked with turnip tops than when cooked alone. If cooked alone, these leafy vegetables were generally more acceptable when seasoned with grease (bacon or salt pork drippings) than when seasoned with butter. They were often rated as fair or poor by family members when boiled with salt pork as in preparing turnip greens. This was probably because boiling with salt pork is conducive to longer cooking, and longer cooking makes these vegetables particularly unpalatable.

There are several vegetables ordinarily used in salad that were introduced to these family groups as cooked vegetables. Most of these vegetable dishes received low ratings. Among these were celery cabbage, purple cabbage, and chayote. Methods of cooking celery cabbage included boiling in salted water and seasoning with bacon drippings. Purple cabbage was boiled with salt pork, and chayote boiled and seasoned with butter. It is important that a new food, especially a vegetable having a very characteristic flavor, be introduced to the family the first time in the form generally found most acceptable to the regional group. Usually this means cooked, but sometimes it means raw.

About 60 percent of the new vegetable dishes listed in table 16 involved a new method of preparing a familiar vegetable; i.e., a new seasoning, a new cookery process. Eight percent of these new dishes involved changes in cooking time, in amount of water used, in cooking with lid off or on. New dishes of familiar vegetables, however, usually represented more change than the foregoing. They usually represented changes in seasoning as well as in cooking process, as, for instance, serving scalloped eggplant, when formerly eggplant had been sliced, dipped in cornmeal and fried. In other words, these new dishes generally meant a new recipe had been tried.

As may be noted from table 16, the vegetable with which there were more new vegetable dishes tried was carrots for the two lowest housing value white and Negro groups. The $20.01 to $40.00 white housing value group tried new dishes of summer squash and of eggplant more frequently, while the over $40.00 white housing group tried new dishes of broccoli and sum-

Table 16. New vegetable dishes tried by families classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new vegetable dishes tried	11	141	212	35	78	48
Vegetable:	Percent	Percent	Percent	Percent	Percent	Percent
Carrots	54.6	14.2	9.0	0	14.1	10.3
Cabbage	9.1	7.8	7.1	2.9	2.6	2.1
Dry beans, including dry butter beans	9.1	.7	1.8	0	2.6	2.1
Soybeans	9.1	1.4	2.4	0	0	0
Sweetpotatoes	18.2	4.3	5.7	2.9	3.8	2.1
Cauliflower	0	5.7	2.8	0	2.6	2.1
Collards	0	2.1	0	5.7	0	0
Irish potatoes	0	6.5	3.8	2.9	3.8	8.3
Radishes	0	1.7	0	0	0	0
English peas	0	1.4	1.4	2.9	1.3	2.1
Spinach	0	11.4	6.1	8.5	10.2	6.1
Wax beans	0	.7	0	0	0	0
Parsnips	0	1.4	.9	0	0	2.1
Onions	0	.7	9	0	1.3	2.1
Swiss chard	0	5.1	5.7	2.9	5.1	2.1
Corn	0	1.4	2.4	2.9	6.4	2.1
Brussels sprouts	0	.7	2.8	0	0	4.2
Eggplant	0	7.8	9.4	8.5	11.5	4.2
Summer squash	0	8.5	10.4	14.0	5.1	2.1
Broccoli	0	.7	5.7	17.1	0	0
Beet tops	0	1.4	.9	0	8.9	4.2
Chinese cabbage	0	1.4	.9	2.9	0	0
Celery	0	.7	1.4	0	0	0
Salsify	0	.7	.9	0	0	0
Green pepper	0	0	0	0	1.3	2.1
Green string beans	0	.7	2.4	0	5.1	8.3
Canned asparagus	0	3.5	3.3	5.7	1.3	4.2
Canned vegetable juice mix	0	.7	.5	0	0	0
Beets	0	.7	1.8	3.0	1.3	4.2
Poke salad	0	.7	0	0	1.3	4.2
Butter beans—fresh	0	.7	.5	0	0	0
Kohlrabi	0	.7	.5	0	0	0
Canned tomato juice	0	2.8	1.4	0	1.3	0
Okra	0	.7	1.4	0	2.6	0
Red cabbage	0	.7	.5	0	0	6.1
Cucumbers	0	.7	.5	0	0	0
Fresh asparagus	0	0	1.4	0	0	0
Kale	0	0	.9	0	0	0
Butter peas	0	0	.5	0	0	0
Artichoke (globe)	0	0	.5	2.9	0	0
Turnip greens	0	0	.5	0	0	0
Dry black-eyed peas	0	0	.5	0	0	4.2
Turnips	0	0	.5	0	0	0
Acorn squash	0	0	0	5.7	0	0
Chinese cabbage	0	0	0	2.9	0	0
Hubbard squash	0	0	0	2.9	0	0
Chayote	0	0	0	2.9	0	0
Tomatoes	0	0	0	0	2.6	2.1
Canned northern beans	0	0	0	0	1.3	0
Mustard	0	0	0	0	0	2.1
Carrot tops	0	0	0	0	1.3	2.1
Kraut	0	0	0	0	1.3	0
Radish tops	0	0	0	0	0	2.1

mer squash more often. Relatively more carrot dishes prepared by the lower housing value groups were new foods than in the case of squash, eggplant, and broccoli prepared by the higher housing value groups.

Many ways of preparing carrots were tried, but mashing, making into cakes and frying, and candying, as in the case of sweetpotatoes, were the two common new methods by those having prepared carrots before. Some combined carrots with other vegetables, such as potatoes or English peas. One novel way was to cook with turnip greens. The homemaker using this method reported favorable family reaction.

Scalloped vegetable dishes, especially scalloped squash and eggplant, was a fashion that swept many groups. Negro families as well as white families tried this method of preparation. Several of the higher housing value white families added shrimp to their scalloped eggplant. First users of eggplant generally fry it; of squash, stew it in a little water and add salt, bacon or salt pork drippings, and sometimes onions, for seasoning.

For those who used spinach, Swiss chard, or beet tops for the first time, there is a marked tendency to use the seasoning and methods used in preparing turnip greens, or to mix and cook these greens with turnip greens. Later, the family may change the seasoning and reduce cooking time. Since there is an association between salt pork or salt pork drippings and flavors from long cooking, it might be well in programs aimed at getting the homemaker to reduce vegetable cooking time, to suggest a new type of seasoning; i.e., butter or margarine, as well as a shorter cooking time.

Vegetables like cabbage, broccoli, and cauliflower are more likely to be seasoned with butter or margarine when prepared the first time than are other fresh vegetables. White sauce and/or cheese sauce were more acceptable on these vegetables once the vegetables were familiar to the family than on other kinds of vegetables. Even here family reaction was often not so favorable.

From all this it might seem that we can draw a few simple rules for making new vegetable dishes more acceptable. They are: In introducing a new vegetable, boil and season with salt and the fat used by the family for similar vegetables. If the new vegetable is beet tops, Swiss chard, poke salad, or spinach, it might well be cooked with turnip greens. Later, when taste for the vegetable is well established, other methods of preparation and seasonings might be tried. The simpler these methods are, the more favorable is likely to be family reaction. Salad vegetables (such as celery cabbage and lettuce) should, of course, be introduced as raw vegetables.

The methods of vegetable preparation used by the Negro families reflected to a large extent those used by the white families. Negro homemakers sometimes prepare in their own homes vegetables as prepared in homes of a white family. White women sometimes give garden seed or help in other ways to their Negro friends. The fact that several Negro families prepared beet tops was because of the influence of the Negro home and county agents in one of these towns (table 16).

For all groups except one, a friend most often suggested the new vegetable dish or recipe tried (table 17). For this group, Negro families with $7.51 to $20.00 housing values, the suggestion most frequently came from a white woman. This source was only second to friends for the Negro group with housing values of $7.50 and under. Suggestions for the new dish often came from magazines, newspapers, or a cookbook for the higher housing value white and Negro families. Many of the homemakers in white families with $7.51 to $20.00 and $20.01 to $40.00 housing values originated their own new vegetable dishes.

Meats and meat alternates. Families in this study tried out 367 new meat and meat alternate dishes. Only 17 of these dishes were new foods, the remainder were new ways of preparing familiar ones. The new foods in this group which were tried included lamb, kid, veal, kidney, deer, squirrel, wild goose, duck, codfish, shrimp, mackerel, and buffalo fish.

Only 3 percent of the 367 new meat and meat alternate dishes were rated as fair or poor by the family. Four of these dishes were loaves—two beef loaves, one salmon loaf, and the fourth a liver loaf. The other low ratings were widely distributed among the entire group and included salt pork floured and fried, venison, kidney, liver cheese, wild goose, Swiss steak, and red snapper baked.

Ground beef was the meat from which more new dishes were made than any other (table 18). Meat rationing may have been in part responsible for this. Ground beef required only a few ration points and is a type of meat that can be extended easily. Only the highest value white group tried another type of meat more often than ground beef. This group tried canned and luncheon meats most frequently. These meats also had a low point value, but were more expensive than ground beef and could not be extended as easily as ground beef could.

Canned fish which is also easily extended ranked second in importance with the two lowest white housing value groups, while chicken and other poultry took second place with the two high white housing value groups. Negro families with values of $7.50 and under prepared new dishes from va-

Table 17. Who or what suggested new vegetables dishes tried by families during past year classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new vegetable dishes tried	11	141	212	35	78	48
Who or what suggested:	Percent	Percent	Percent	Percent	Percent	Percent
Friends	37	33	33	31	34	19
Home economists	18	3	5	0	4	4
Recipes from magazines, cookbooks, newspapers	9	7	17	17	1	19
Relatives	18	15	5	11	12	17
Advertising material	18	8	3	3	3	2
Thought it up	0	19	19	9	4	2
Seeing in store or having clerk call attention to	0	6	6	6	1	4
Family members	0	6	6	3	3	2
Eating out	0	2	2	8	0	0
Cook	0	1	3	12	0	0
Agricultural teacher	0	0	1	0	3	0
Physician	0	0	0	0	3	4
White women	—	—	—	—	31	27
Public relief	0	0	0	0	1	0

Table 18. New meat and meat alternate dishes tried by families classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new meat and meat alternate dishes tried	8*	113	152	20	46	28
Meats and meat alternates:	Number	Percent	Percent	Percent	Percent	Percent
Beef						
Ground	2	23.0	20.4	10.0	15.2	14.3
Steak	0	8.0	7.2	5.0	0	3.6
Roast	0	8.8	3.9	0	2.2	10.7
Stew	0	5.3	3.3	0	15.2	7.1
Dried	0	0	.7	0	0	0
Veal	0	1.8	0	0	2.2	0
Pork						
Sausage and weiners	0	.9	0	0	4.3	3.6
Chops	0	5.3	2.0	5.0	2.2	7.1
Roast	0	.9	2.0	0	0	3.6
Spareribs	0	3.5	2.0	0	2.2	10.7
Ham	0	2.6	3.3	5.0	0	3.6
Salt pork and bacon	0	0	2.0	0	2.2	7.1
Lamb	0	.9	0	0	2.2	0
Kid	0	.9	0	0	0	0
Chicken and other poultry	0	8.0	9.2	15.0	4.3	3.6
Game	0	0	2.6	5.0	2.2	0
Canned meats, luncheon meats	0	6.2	7.9	25.0	0	0
Variety meats	0	5.3	5.9	5.0	15.2	3.6
Left-over meat and poultry	0	1.8	7.9	0	6.6	0
Canned fish	4	10.6	7.2	5.0	8.7	7.1
Fresh and frozen fish	1	3.5	4.6	10.0	4.3	7.1
Dried fish	0	0	0	0	4.3	0
Cheese dishes	1	0	1.3	5.0	4.3	3.6
Egg dishes	0	1.8	5.9	5.0	2.2	3.6
Peanut dishes	0	.9	.7	0	0	0

*Percentages are not given where there are less than 10 cases.

riety meats as often as they did from ground beef. Variety meats included liver, brains, and kidney.

It is, of course, impossible to state to what extent rationing was responsible for the new meat dishes tried. It seems doubtful if it had very much direct effect on families in the lower housing value groups, since some homemakers in these groups spoke of not using up all their red stamps. It will also be noted that several families in the $7.51 to $20.00 white and Negro housing groups tried a new method of preparing roast beef, a meat requiring quite a few ration points. Many of these families had more money than they had previously and so could try new ways of cooking beef and pork.

Rationing undoubtedly did have some direct effect on new meat and meat alternate dishes tried by higher housing value families. The fact that there were a number in these groups trying new dishes of poultry, an unrationed meat, and that families in the highest housing value group most frequently tried new canned and luncheon meats would support this assumption.

Ground beef was most frequently prepared in meat balls. New ways of preparing these meat balls were indeed varied and included, among others, mixing with raw grated Irish potato, with ready-prepared cereals of various kinds, with rice; cooking with barbecue sauce, with tomato sauce, with spaghetti; broiling in butter; and baking in the oven. New dishes made from ground beef were about half as often loaves as balls and were not on the whole as well received by the family as the ball or hamburger.

Various new methods of extending canned fish were tried out, salmon being the canned fish most frequently tried, especially by the lower housing value groups. The most common new dish prepared was salmon loaf using many new kinds of extenders. Very few prepared new recipes of salmon croquettes. Salmon was used by several for the first time as a salad with apples added. Among other new salmon dishes prepared were: salmon scrambled with egg, salmon pie, scalloped salmon. The higher housing value groups of white families prepared several new dishes from canned tuna, among which were tuna with noodles and white sauce; tuna with capers, cherry wine and white sauce.

Most of the new ways of preparing variety meats were like those for ground beef and canned fish—new attempts at extending flavor, such as addition of vegetables, or making into a loaf with addition of bread or cereal, or serving with a cornbread dressing.

While the trend in preparing ground beef, canned fish, and variety meats was towards extending flavor by addition of other foods, for meats such as stew beef, roast beef, beefsteak, poultry, fresh and frozen fish, it was toward change in method of cookery. The most frequent new way of using stew beef was of preparing it as one ordinarily prepares country fried steak (slicing, flouring, browning in fat, adding water, and stewing in gravy). The most popular new method of preparing roast was cooking it entirely or partly in the oven instead of partly or entirely on top of stove, as previously. More homemakers tried broiled steak than any other new steak dish. Baking young chicken, when formerly frying had been the only method in use, was the new chicken dish most frequently tried. New methods of preparing fish involved most often a shift from frying to baking. Fat rationing was no doubt in part responsible for some of these changes. The fact that such changes met with family approval may mean that these methods will continue to be used after fat rationing is over.

The most frequent new dish of pork spareribs was barbecued ribs. Barbecued chicken and barbecued pork roast were also tried by a number for the first time. Barbecuing met with general approval and was apparently on the increase.

New luncheon and canned meats were usually served as purchased, though some homemakers broiled them in butter or some other kind of fat. A few women made these meats into scalloped dishes, though this was not typical. Meat or meat alternates used in scalloped and casserole dishes were usually meats very familiar to the family. Several used ham, eggs, and left-over meats in this manner.

New dishes of peanuts and cheese were combinations with cereals. The most popular type of new egg dish was a combination of eggs and tomatoes. Eighty-six percent of the new meat and meat alternate dishes involved a change in ingredients used, including seasonings; the remainder did not, and included a shift to baking, to broiling, to frying; preparation for the first time in a pressure cooker; preparation for the first time in a steamer.

In table 19 is given the source for suggestions of the new meat dishes tried. As will be noted, the most important source for all groups was a friend. Recipes from magazines, cookbooks, and newspapers was the next important source. Many of the Negro homemakers received their information for preparation of these new dishes from white women. A number of white women in the $7.51 to $20.00 and $20.01 to $40.00 housing groups originated the new meat or meat alternate dishes they tried. Seeing in store or having clerk call attention to was an important source for the over $40.00 housing group of white homemakers. Cooks and eating out were also important sources for the new dishes.

Salads. Salads include vegetable and fruit combinations. Meat, fish, and egg salads were classified as meats or meat alternates and included a total of 17. Therefore, the actual number of new salads tried was 284, rather than 267 shown in table 20. By a new salad is meant that a new vegetable or fruit is used for the first time, or that a familiar vegetable or fruit is used for the first time in a salad; (it may have been used quite often before in a vegetable or fruit dish), or that a new combination of fruits and vegetables, or a new form, i.e., frozen, congealed, is used, or that a new dressing is used.

Twenty-three vegetables and fruits were used in these salads for the first

Table 19. Who or what suggested new meat and meat alternate dishes tried in families during past year classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new meat and meat alternate dishes tried	8	113	152	20	46	28
Who or what suggested:	Number	Percent	Percent	Percent	Percent	Percent
Friends	3	25.6	30.4	35.0	23.9	28.5
Recipes from magazines, newspapers, cookbooks	1	13.3	21.0	25.0	17.4	21.4
Relatives	1	15.9	6.0	0	10.9	0
Home economists	0	.9	1.3	0	2.2	0
Advertising material	1	8.0	2.6	0	6.5	3.6
Family member	1	7.1	6.0	5.0	2.2	10.7
Government and State agricultural bulletins and leaflets	1	0	0	0	0	0
Thought it up	0	21.2	14.4	0	4.3	3.6
Eating out	0	1.8	3.9	10.0	0	3.6
Seeing in store or having clerk call attention to	0	4.4	7.2	15.0	0	3.6
Cook	0	0	4.6	10.0	0	0
Physician	0	1.8	2.6	0	2.2	3.6
White woman	—	—	—	—	30.4	21.4

Table 20. New salad dishes tried by families classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new salad dishes tried	3	80	126	16	19	23
Salad dishes:	Number	Percent	Percent	Percent	Percent	Percent
Vegetable	1	31.3	33.3	31.4	57.9	60.9
Fruit	0	11.2	19.8	12.5	0	21.8
Congealed	0	18.7	16.7	25.0	0	0
Fruit and vegetable mixtures	1	18.7	14.3	6.2	15.8	8.7
Potato and macaroni	1	7.5	4.0	6.2	10.5	0
Frozen fruit and vegetable	0	3.8	4.0	12.5	0	4.3
Dressings and mayonnaise	0	8.8	7.9	6.2	15.8	4.3

time by families of this study. As has been stated before, serving as a salad it not the usual way to introduce a strange vegetable or fruit to the family and, therefore, the list is not extensive. Nine families introduced carrots to their families in salad and in only one case was this salad given a low rating by the family. This is a better reception than the cooked carrot met.

Avacado was the new fruit most often introduced to the family in a salad. Eight homemakers reported they tried it for the first time and all except one of these rated family reaction as good or excellent.

Other new foods introduced for the first time in these salads include globe artichoke, Chinese cabbage, celery, lettuce, and red cabbage. The two families who reported using lettuce for the first time were Negro families and in one case the family doctor had advised its use. Three families tried mayonnaise for the first time. Mayonnaise is classified as a new food.

About 97 percent of all the salad dishes tried were rated as good or excellent by the family. The percentage of new salads with high ratings is almost as high as that of new desserts. Homemakers are no doubt rather cautious about experimenting with new mixtures, such as salads and desserts. Also, there may have been a tendency on the part of some homemakers to picture family reaction in better terms than was actually the case.

For all groups the most common new kind of salad prepared was a vegetable salad (table 20). Vegetable salads using carrots, either for the first time in salad or for the first time at all, took first place. Salads using English peas for the first time in salads were also popular as were new combinations of cabbage and other vegetables and the use of beets in salads. Fewer new fruit salads than vegetable salads were prepared (table 20). No new fruit salads were prepared by a white or Negro family in the $7.50 and under housing group.

Families of low socioeconomic status are more likely to use potato salad than any other kind of salad. The potatoes are mashed and butter (or an alternate), vinegar, onions, and hard cooked eggs added. As the family rises in the socioeconomic scale, it changes from mashing to dicing the potatoes used in salad. Slaw is also a popular salad with the low socioeconomic groups as with other groups.

Mustard greens, turnip tops, spinach, cauliflower, and tomatoes[8] were among other raw vegetables tried in salad; asparagus, string beans, butter beans, and "pork and beans" among the other cooked or canned vegetables tried.

The most common type of fruit salad tried was a new combination of fruits. Other new fruit salads included: pickled pear, cherry, grapefruit, apricot, raisin, apple, banana, and pear.

As will be noted in table 20, a number of homemakers tried fruit and vegetable mixtures. Most of these mixtures were of cabbage and apple, or cabbage and pineapple, or the like. However, in the $20.01 to $40.00 housing group there were five homemakers who served rather unusual mixtures; i.e., orange and onion; tomato and pineapple. Surprisingly, the family reaction to these unusual mixtures was reported as favorable, except in one case. New congealed and frozen salads were limited, for the most part, to the higher housing value groups. A congealed dessert is much more likely to be served by the typical family than is a congealed salad. In fact, serving congealed desserts often leads to serving congealed salads. Frozen salads are limited to the group with mechanical refrigerators.

Several homemakers prepared boiled salad dressing for the first time. Rationing of oil may have been partly responsible for this. Negro homemakers in the $7.50 and under housing group tried more new dressings than any other group. Some of these women were at the transition point when one occasionally serves raw tomatoes or canned fruit with dressing when formerly these had been altogether used as a vegetable or fruit dish.

As in the case of other types of foods, the most important source for suggestions for the new salads tried was a friend (table 21). "Thought it up" was also a very important source, especially so for the $7.51 to $20.00 Negro housing value group. Recipes from magazines, cookbooks, and newspapers were not important except for the $7.51 to $20.00 and $20.01 to $40 housing groups of white families. A white woman was a very important source for the $7.50 and under Negro group.

Fruits. New fruits or new methods of preparing familiar fruits were regarded as new fruit dishes. Only 22 new fruits were tried. Twelve families tried grapefruit for the first time, two tried prunes, two boysenberries, two dates, and one each loganberries, youngberries, pomegranates, and white figs.

Only 2 of the 75 fruit dishes tried were not favorably received by the family. Both of these were new fruits for the family and both were grapefruit. Fresh grapefruit is tried by the homemaker and when the family acquires a taste for it, the canned juice may be purchased. This juice is not regarded as a new fruit when fresh fruit has previously been served. However, it is a new fruit dish. If family members like fresh grapefruit, then it is quite likely that they will like the canned juice.

Table 22 lists the kinds of new fruit dishes tried. As will be noted, baked or stewed fresh fruits of various kinds was the most important type

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[8] Sliced tomatoes are not regarded as a salad. Practically all families serve sliced tomatoes during season; a number never serve tomato salad.

Table 21. Who or what suggested new salad dishes tried by families classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new salad dishes tried	3	80	126	16	19	23
Who or what suggested:	Number	Percent	Percent	Percent	Percent	Percent
Friend	2	36.2	30.9	25.0	47.6	39.2
Recipes from magazines, cookbooks, newspapers	0	13.8	16.7	0	0	4.3
Family members	0	12.5	9.5	12.5	0	4.3
Relatives	1	10.0	10.3	6.2	5.2	4.3
White woman	—	—	—	—	26.4	8.7
Physician	0	0	0	0	5.2	0
Thought it up	0	23.7	19.8	25.0	5.2	39.2
Advertising material	0	1.3	2.4	6.2	5.2	0
Home economist	0	2.5	4.8	0	5.2	0
Seeing at store or having clerk call attention to	0	0	3.2	18.9	0	0
Cook	0	0	1.6	0	0	0
Eating out	0	0	.8	6.2	0	0

of new fruit dish. Sixty percent of these dishes involved substitution of some form of sweetening for sugar. The remaining 40 percent were new recipes; i.e., baking or candying pears, peaches, and bananas for the first time.

All except two of the new canned fruits and juices reported were juices. Juices included grapefruit, orange, a mixture of the two, and pineapple juice. New fruit juices preserved by the family are included under "home food preservation."

A physician and a relief agency were relatively more important in the use of a new fruit dish by these families than in the case of a new dessert, salad or meat dish (table 23). Advertising material and recipes from magazines, newspapers, and cookbooks were less important.

Breads and cereals. The homemakers of this study reported 210 new bread and cereal dishes tried during the schedule year. Eighty-one percent of these new dishes were reported by homemakers from white families in the

Table 22. New fruit dishes tried by families classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
	Number	Number	Number	Number	Number	Number
Total new dishes tried:	5	13	29	3	17	8
Fresh fruits	1	5	4	0	10	2
Canned fruits and juices	2	3	9	0	4	3
Dried fruits	0	1	2	0	2	0
Baked or stewed fresh fruits	2	4	14	3	1	3

$7.51 to $20.00 and $20.01 to $40.00 housing value groups. These groups made up 53 percent of the families in this study.

Thirty-two of the 210 new breads and cereals were new foods; i.e., grain products which the family had not before been served in any form, or the use of a whole grained product when the family had previously used a refined product only. The latter type of new food was more common than the former. Grain products (or legumes used as grain products) which the family had not before been served included oats, rye, and soybeans. The most common was soybeans, including 9 of the 14 new grain products tried.

Only 2 of the 12 breads and cereals reported by the homemakers as receiving fair or poor reception from family members were new grains (or legumes used as grain products). Five were whole grained wheat products when formerly only refined products had been used, and five were new recipes or new forms of a familiar type of grain or grain product.

It is interesting to note that of the eight families trying soybeans as a vegetable, four reported fair or unfavorable family reaction. Of the nine families trying soybeans in the form of flour in homemade breads and in bakery products, only one family reported such reaction.

The most frequent type of bread and cereal tried in the $7.51 to $20.00 and $20.01 to $40.00 white housing value groups, the two big groups of families trying these products, was ready-prepared cereals (table 24). The next type in importance was homemade breads. New recipes for, or the use of, new flours in muffins and rolls was the most common type of homemade bread dish tried.

More families first tried whole-wheat in the form of bakery whole-wheat bread and crackers than bought whole-wheat flour and made breads with it at home. This is just another example of the principle that the less time con-

Table 23. Who or what suggested new fruit dishes tried by families classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total fruit dishes tried	5	13	29	3	17	8
Who or what suggested:	Number	Number	Number	Number	Number	Number
Seeing at store or having clerk call attention to	1	1	5	0	1	2
Thought it up	1	2	4	1	1	1
Friends	1	1	6	2	1	0
Relatives	0	3	2	0	2	2
Family members	1	1	4	0	2	0
Recipes from magazines, newspapers, cookbooks	0	0	1	0	0	0
Physician	0	3	3	0	4	0
Government and State agricultural bulletins and leaflets	0	0	2	0	0	0
Advertising material	0	0	1	0	1	0
White woman	—	—	—	—	1	0
Public relief	1	0	0	0	4	2
Home economist	0	2	1	0	0	1

Table 24. New bread and cereal dishes tried by families classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new bread and cereal dishes tried	3	73	98	12	15	9
Breads and cereals:	Number	Percent	Percent	Percent	Percent	Number
Bakery products	1	11	11	8	27	0
Homemade breads	0	36	36	42	33	7
Ready-prepared cereals	0	46	44	33	27	1
Cooked cereals	2	7	9	17	13	1

suming and the more simple the form in which a new food can be introduced, the more likely it is to be tried.

Seeing at store or having clerk call attention to was the most important source for suggestions of new bread and cereal dishes tried (table 25). Advertising material was also mentioned by a number of women. Another source of suggestion for new bread and cereal dishes was family members. Several stated that their children suggested they try a new ready-prepared cereal. The fact that advertising of ready-prepared cereal is frequently directed to boys and girls may have been in part responsible. Other boys and girls may also have been in part responsible.

About 63 percent of the suggestions concerning new dishes actually tried by the homemakers and made by family members came from "daughter,"

Table 25. Who or what suggested new bread and cereal dishes tried by families during past year classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new bread and cereal dishes tried	3	73	98	12	15	9
Who or what suggested:	Number	Percent	Percent	Percent	Percent	Number
Physician	1	0	1	8	13	0
Seeing at store or having clerk call attention to	1	32	33	34	33	1
Government and State agricultural bulletins and leaflets	1	0	0	0	0	0
Advertising material	0	25	21	8	7	0
Friend	0	20	12	17	0	0
Family members	0	15	18	8	13	2
Recipes from magazines, newspapers, cookbooks	0	4	13	17	0	1
Home economist	0	3	1	0	7	0
Thought it up	0	1	0	8	7	1
Relatives	0	0	0	0	13	2
Cook	0	0	1	0	0	0
Eating out	0	0	0	0	7	0

"son," or "children." Eighty-three percent of the suggestions coming from these were listed as coming from daughter.

The question might be raised at this point: Is it the role of women and girls to suggest and men and boys to acquiesce, or are new dishes to be served a consideration for the family in toto?

Home food preservation. Ninety percent of the new food preservation dishes were tried by families in the $7.51 to $20.00 and $20.01 to $40.00 housing value white groups. These groups, as before stated, constituted 53 percent of the families in the study. In these two groups, as well as in the other groups, more new kinds of canned vegetables were tried than any other type of food preservation (table 26). The seven vegetables that were most often canned by homemakers for the first time, in order of importance, were: squash, turnip greens, string beans, vegetable mixture, okra, carrots, and cabbage (not kraut). The entire list included 24 different vegetables. Four homemakers had canned tomatoes for the first time during the report year.

The Victory Garden movement, rationing of canned vegetables, and prospect of even greater shortages of canned vegetables in the future, were no doubt all factors in the variety of new vegetables canned for the first time in homes of families studied.

Four of the 38 new canned fruits tried involved substitution of other sweets for part of the sugar; i.e., corn sirup and honey, while 22 of the 45 new jellies, jams, marmalades, and preserves involved such substitution. Pears was the fruit most often canned for the first time by these homemakers.

The two most important sources for suggestions for new preserved foods were friends and advertising material (table 27). Many of these homemakers took their directions for food preservation from booklets published by glass jar companies. These booklets were no doubt secured when jars were purchased. Is business more successful in getting families to try new food dishes than are food and nutrition specialists? What methods does business use that might profitably be used by these educators?

Table 26. New kinds of food preservation dishes tried by families classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new food preservation dishes	0	123	144	6	16	9
Home preserved foods:	Number	Percent	Percent	Number	Percent	Number
Canned meats	0	6	8	0	6	0
Canned vegetables	0	57	42	5	38	5
Canned fruits	0	13	15	0	6	0
Dried fruits and vegetables	0	2	2	0	0	0
Frozen fruits and vegetables	0	2	2	1	0	0
Juices	0	6	4	0	0	0
Pickles and chili sauce	0	6	8	0	19	1
Jellies	0	2	4	0	12	0
Jams, preserves, marmalades, and mincemeats	0	6	15	0	19	3

Table 27. Who or what suggested new food preservation dishes tried by families classified by race and housing value of families.

Item	White families	White families	White families	White families	Negro families	Negro families
	Housing $7.50 and under	Housing $7.51-$20	Housing $20.01-$40	Housing over $40	Housing $7.50 and under	Housing $7.51-$20
Total number of new food preservation dishes	0	123	144	6	16	9
Who or what suggested:	Number	Percent	Percent	Number	Percent	Number
Friend	0	23	24	0	38	1
Recipes from magazines, newspapers, cookbooks	0	4	4	0	12	0
Family members	0	13	2	0	0	0
Relatives	0	13	3	0	6	0
White woman	—	—	—	—	12	1
Physician	0	2	1	0	0	0
Thought it up	0	12	20	0	0	2
Advertising material	0	24	34	4	25	2
Home economist	0	14	3	1	6	1
Seeing at store or having clerk call attention to	0	2	3	0	0	0
Government and State agricultural bulletins and leaflets	0	2	4	0	0	0
Agricultural teacher	0	1	1	0	0	2

Food Preparation in Own and in Parental Home

The method of analyzing new dishes prepared during the previous year, reactions of family members to these dishes, and who suggested, as a means of studying changing pattern of food preparation, has an advantage over the method of comparing food preparation in own and in parental home, the method to be used in this section of the report. It is probably more accurate. On the other hand, the method of analyzing new dishes tried showed the changing pattern of preparation during World War II, or during a time when there was rationing of food. A comparison of food preparation in own and parental home will give some of the long run changes not shown by the first method and for this reason seemed worth using.

Preparation of twelve foods in both homes. A method worked out in a previous study with farm homemakers and found satisfactory was used.[9] This method consisted in asking the homemakers who stated that the foods named (cornbread, biscuit, salt pork, beef, eggs, cooked cabbage, slaw, milk, canned tomatoes or juice, canned string beans, sweetpotatoes) were served in own home and in home of parental family as often or more often than once or twice a week, or daily, depending on the food, one or two general questions concerning methods of preparation or serving of the foods in these two homes. In the tabulations which are to follow, two groups are, therefore, not included: (1) those who stated they do not remember about food preparation of these foods in parental home; (2) those who stated the foods questioned about were not served as frequently as named in own or in parental home or in both homes. In other words, the tabulations are limited to those families serving the foods in own and parental homes fairly often.

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[9] Dickins, Dorothy, op. cit., p. 57.

Data concerning food preparation of each of the foods were obtained very much as the data for sweetpotatoes. The manner of securing data on sweetpotatoes was very much as follows: "You say you serve sweetpotatoes three times a week or more when they are in season. Did you have them about as often when you were a child? Less often? More often?" If the homemaker when a child had apparently been served sweetpotatoes as often as three times a week when in season, she was asked about the most common method of cooking them: baked, fried, candied, in her own and in her parental home. If the method of preparing sweetpotatoes ordinarily used in the two homes was different, the homemaker was asked if she could account for the difference.

Some homemakers who ordinarily used methods for food preparation which differed from those ordinarily used by their parental families were unable to give the factors causing change in preparation. Sometimes the change had been so gradual that the homemaker herself was unaware until questioned that it had been made. Some of the reasons given for making changes were quite subjective. Yet this method does throw some light on factors bringing about changes in food preparation.

In table 28 is given the proportion of families in which the homemaker reported she prepared the foods named the same and differently from the way her parental family usually did. The majority of homemakers in all groups reported that they prepared each of the 12 foods except 2—cooked cabbage and slaw—as had their parental families. However, a number of homemakers in every group reported preparing each of the other 10 foods differently from the way they were prepared in their parental homes.

The methods of preparing or serving the 12 foods listed were more often different in the family and in the parental family of homemaker in families with homemakers over 40 years of age than in families with homemakers of 40 years and under (table 28). The older homemaker may not have changed her methods as rapidly in a given time as the younger homemaker (the first method of studying changing food preparation pattern indicated that she did not), but the older homemaker had made more changes in toto during her homemaking career than had the younger one. This was because during her long career as a homemaker had come many changes in food preparation facilities, substitute foods, and research findings that impelled change in preparation, whether change was willed or not. It was also because more of the older women had been farm reared and had shifted from a farm to a small town economy.

Some of the situations mentioned by one or more older homemakers as having brought changes in food preparation in their time were:

I. Changes in food preparation equipment.
   1. From fireplace cooking to stove cooking.
   2. From use of wood as fuel to use of kerosene, gas, electricity.
   3. Particular parts of the modern cook stove mentioned in connection with changing preparation: deep wells (in electric stove), broilers (in gas and electric stoves), better ovens, in which heat can be controlled.

Table 28. Proportion of families in which 12 foods were prepared the same and differently by family now* and in home of parental family of homemaker when she was at home, classified by housing value and race of families and by age of homemakers.

Item	White families		White families		White families		Negro families	
	Housing $20 and under		Housing $20.01-$40		Housing over $40		Housing $20 and under	
	Homemaker		Homemaker		Homemaker		Homemaker	
	Over 40 years	40 yrs. and under	Over 40 years	40 yrs. and under	Over 40 years	40 yrs. and under	Over 40 years	40 yrs. and under
Total number families	150	159	203	135	36	15	195	263
Cornbread:								
No. records both homes	120	129	152	104	22	10	177	237
Pct. prepare same	73	83	84	89	82	90	61	66
Pct. prepare differently	27	17	16	11	18	10	39	34
Biscuit:								
No records both homes	90	111	128	89	18	6	117	218
Pct. prepare same	62	67	85	88	83	**	58	63
Pct. prepare differently	38	33	15	12	17	—	42	37
Salt pork:								
No. records both homes	102	114	142	100	22	10	152	216
Pct. prepare same	81	87	92	97	91	100	83	90
Pct. prepare differently	19	13	8	3	9	0	17	10
Beef:								
No. records both homes	13	42	64	72	19	11	3	33
Pct. prepare same	62	69	59	68	53	64	—	70
Pct. prepare differently	38	31	41	32	47	36	—	30
Eggs:								
No. records both homes	83	95	142	97	26	10	88	126
Pct. prepare same	67	82	63	71	65	70	69	84
Pct. prepare differently	33	18	37	29	35	30	31	16
Cooked cabbage:								
No. records both homes	75	83	91	68	16	8	117	171
Pct. prepare same	20	34	18	43	19	—	46	50
Pct. prepare differently	80	66	82	57	81	—	54	50
Slaw:								
No. records both homes	70	104	109	96	19	12	8	30
Pct. prepare same	31	54	16	48	20	50	—	53
Pct. prepare differently	69	46	84	52	80	50	—	47
Milk:								
No. records both homes	90	99	128	88	12	10	78	118
Pct. serve same	80	86	75	89	67	90	74	81
Pct. serve differently	20	14	25	11	33	10	26	19
Canned tomatoes:								
No. records both homes	51	98	61	68	11	8	10	79
Pct. prepare same	69	70	65	68	73	—	70	72
Pct. prepare differently	31	30	35	32	27	—	30	28
Oranges:								
No. records both homes	11	42	31	59	5	9	8	10
Pct. serve same	73	86	60	64	—	—	—	90
Pct. serve differently	27	14	40	36	—	—	—	10
Canned string beans:								
No. records both homes	38	87	59	81	8	9	19	132
Pct. prepare same	87	90	78	80	—	—	89	94
Pct. prepare differently	13	10	22	20	—	—	11	6
Sweetpotatoes:								
No. records both homes	90	100	138	95	18	7	146	210
Pct. prepare same	89	90	76	84	78	—	88	87
Pct. prepare differently	11	10	24	16	22	—	12	13

*Or before rationing for rationed foods. **Percentages not given where less than 10 cases.

4. Other equipment named as bringing about change: steam pressure cookers, pressure sauce pans, waterless cookers, steamers, glass and aluminum cooking utensils, smaller cooking utensils.
5. From cooling food in a cistern or spring to cooling in an ice box, ice refrigerator, mechanical refrigerator.

II. Development of the science of nutrition.
  1. Cooking to conserve minerals and vitamins.

III. Introduction of teaching of food preparation in schools, in colleges, in adult and youth groups outside schools. (Beginning of agricultural extension home economics work.)

IV. Changes in methods of preserving vegetables and fruits.
  1. From drying and brining to canning in open kettle and preserving (including use of canning acid in non-acid vegetables, such as string beans on the part of some homemakers; preserving fruit by cooking with large amounts of sugar).
  2. Development of modern canning techniques, including hot water bath and the pressure cooker method of canning.
  3. Beginning of the period of the freezer locker.

V. Changes in methods of preserving meats.
  1. From curing to canning.
  2. Beginning of the period of the freezer locker.

VI. New food products and substitutes for other products brought on the market
  1. Large variety of ready-prepared foods available.

VII. More palatable milk because of refrigeration, grading, pasteurization.

VIII. Improved market facilities brought about in part by better transportation, better storage. (The grocer thus carries oranges all year, instead of at Christmas time.)

IX. Development of food advertising.

X. Introduction of the radio.

XI. Shift from a farm to a small town economy.

XII. Smaller families.

From the list just given it is evident why the older homemaker would have made more changes, during her long career as a homemaker, than would the younger homemaker. The surprising thing is that there is not even more difference than shown in preparation of the 12 foods listed in own and parental home in the two age groups. No doubt the tendency of the older woman to try fewer new dishes is in part responsible.

Homemakers in families of different housing values varied according to food about which questioned as to proportion using different methods of preparation from those used in parental home (table 28). There had, for instance, been greater change in preparation of cornbread, biscuit, and salt pork in low housing value groups. On the other hand, there had been more change in preparation or method of serving of slaw, oranges, and canned string beans in the higher housing value groups. Families of higher housing value had on the whole made more changes in the 12 foods listed than families of lower housing value.

Negroes had made changes less often than had whites (table 28). But the housing value group $20.00 and under of Negroes contained relatively six times more families with housing values of $7.50 and under than did the housing value group $20.00 and under of whites.

In table 29 is listed all the factors mentioned by homemakers in explaining differences in usual methods of preparing the 12 foods in own and parental home. As will be noted, preferences of self, of husband, of children, of family, were quite often mentioned by all groups. In fact, they included about one-third of all the factors reported in every group.

Older women quite frequently gave as a factor explaining change from vinegar slaw to slaw made with salad dressing or mayonnaise the appearance of such dressing on grocery shelves. A number mentioned the difference between walking a block or two to the grocer's and riding 10 miles over a muddy road made in kind of recipe actually used. Young white women often spoke of training in food and nutrition, especially in connection with preparation of boiled cabbage, canned beans, and canned tomatoes.

Negro women in both age groups used "costs less" or "takes less fuel" to explain many of their new practices. "Why do you use self-rising flour now in making biscuits?" "Because it's cheaper." "You say your family always

Table 29. Factors reported by white and Negro homemakers to account for differences in preparation of 12 foods in own and in parental home.*

Factors causing differences	Reported by			
	White homemakers		Negro homemakers	
	Over 40 years	40 years and under	Over 40 years	40-years and under
	Percent	Percent	Percent	Percent
Quicker, easier, more convenient	6.7	9.6	3.1	5.0
Husband likes	7.6	11.9	15.0	12.1
A child likes	7.4	6.3	2.1	5.8
Family members like	4.4	4.9	4.9	2.4
Like better	15.2	11.1	10.4	12.1
Relatives	.4	.8	.7	.7
Friends	1.0	2.0	.9	1.4
Reading	1.9	3.4	.7	1.2
Food and nutrition education at school, in clubs and from contacts with workers	6.3	12.8	2.4	7.1
Change in market or market facilities or ease of getting to market	20.2	7.2	6.1	3.6
Advertisements	.5	.7	.7	1.0
Difference in size of family to cook for	.9	.7	.3	.7
Physician's advice or diet of self or other family members	3.6	2.4	8.0	5.2
Change in equipment	3.6	1.7	2.4	1.0
Health	4.3	3.1	10.8	6.9
Cost less—takes less fuel	4.1	6.0	19.0	23.0
Have more money than family	1.0	.8	1.2	1.4
New recipe or new method developed	4.1	3.6	4.9	2.4
No longer produce at home	2.2	1.4	3.1	1.2
Nutritive value	3.3	7.2	1.2	2.0
White woman	—	—	1.5	2.4
All other causes	1.3	2.4	.6	1.4
Total	100.0	100.0	100.0	100.0
Total number of factors reported	788	586	326	421

*Where homemaker and parental family were said to both serve the food as often as mentioned and where methods differed the housewife was asked why she made change. In some cases she had no explanation to offer. In other cases she gave more than one explanation. This table contains all factors mentioned.

baked their sweetpotatoes and that you fry yours most of the time. Why did you change your way of cooking?" "It takes less wood."

As will be remembered when these homemakers were asked to list new dishes tried and who suggested, friends was the source for suggestion most often mentioned by all groups. Here,when they were asked to explain why they no longer prepared cooked cabbage, beef, or sweetpotatoes as it was prepared at home, friends were rarely mentioned. This seeming discrepancy is not one at all. The question "Who or what suggested the new recipe of "5-minute cabbage" tried? is, for instance, not the same as the question, "What led you to serve cooked cabbage green and white in appearance when cabbage brown in appearance was served in your parental home?" In the first instance a friend may have given the recipe, but the idea for short cooked cabbage may have come from a demonstration at an agricultural extension club attended. Sources of suggestions for new dishes tried give information concerning the final factor causing action. Explanations for differences in methods of preparation in own and parental home give information (though often subjective) concerning factors which the homemaker considers most important. These may not be the final factors at all.

A discussion of some of the differences in preparation of the 12 foods listed in own and parental homes of the families included follows:

Cornbread. Those homemakers usually serving cornbread or who were served cornbread in their parental home three times a week or more were asked which type of cornbread was prepared most often: water bread, milk bread, or milk-egg bread. As will be noted from table 28, the majority in all groups prepared cornbread the same as it had been prepared in the parental family of the homemaker. More Negro women than white women, however, prepared it unlike their parental family. More of the white women in the lower than in the higher housing value groups had changed their method of preparation. Many homemakers in the low housing value white and Negro groups had been reared in homes of poor farm families who had a very limited number of milk cows and hens, with low production of milk and eggs by those that they did have, little or no cash to purchase milk and eggs, and poor facilities for getting to a market to purchase these animal products as well as limited facilities for keeping them once they were purchased.

The most frequent change in cornbread preparation in own and parental homes of white families was in the use of milk-egg bread, instead of milk bread; in own and parental homes of Negro families was in the use of milk bread instead of water bread. The explanation most commonly given by white homemakers for the change in preparation was availability of eggs; by Negro families, availability to milk. Egg or milk were more available to these town families because there was more cash to purchase them or because a supply of the same was within closer vicinity. The reason of next importance given was preference of husband or some other member of the family. Other causes given for changes were milk-egg bread, or milk bread "healthier," "fluffier," "was given a recipe for this kind of bread," "like better," "cornmeal not as good as formerly and so must add milk and eggs," "have oven to bake bread," "learned from white family."

Biscuit. Information concerning whether biscuit was ordinarily prepared with plain or self-rising flour, with milk or with water, was secured from those families serving biscuit three times a week or more. As shown in table 28, the greatest change in biscuit preparation, as in cornbread preparation, had taken place in low housing value groups, and in Negro families. This can be attributed for the most part to the large number of these families using self-rising flour, this flour less often being used in parental homes because it was not on the market or when first introduced there was a question as to the "healthfulness" on the part of many. Some of the reasons given for changing to self-rising flour were: "makes lighter biscuits," "is easier to make," "don't always have milk," "afraid of putting in too much soda," "on market," "cheaper," "don't have to use other ingregients," "can't make good soda biscuits," "husband won't buy plain flour," "girls make better biscuit with self-rising flour." On the other hand, a few families had changed to plain flour because of "health," "doctor's orders."

It is interesting to note that biscuits were used more frequently in homes of low housing value groups than had been used in parental homes of homemakers, but that they were used less in higher housing value groups than in parental homes of homemakers. This was because biscuits were formerly a treat to the low income farm family such as were many of the families in which these women were reared. "Had biscuit once a month when a child," "had biscuit only on Sunday," "my family used to serve biscuit twice a week." These were some of the comments made by women in these groups. There are many substitutes for biscuit on the market now, especially for the higher housing value town family; i.e., homemade rolls, bakery products.

There were almost as many families using cornbread three times a week or more now as had used it this often in parental homes of homemakers, This was no doubt because for the majority of Mississippi people there is no substitute for cornbread. It "just naturally goes with certain of the strong flavored vegetables."

Salt pork. Those homemakers usually serving salt pork or who were served salt pork in parental homes one time a week or more were asked whether the salt pork was used most frequently as meat; that is, fried and served as breakfast bacon, or as seasoning with vegetables. As will be noted from table 28, the majority in all groups used salt pork as it had been used in the parental home of the homemaker. More low than high housing value groups, however, used salt pork differently from the way it had been used in the parental home of homemaker. In the parental homes of these women it had more frequently been used about as often as meat and as seasoning. Now fewer of these families used it as meat. Some of the reasons for this change given were: "bacon available," "more other meats available," "parental family produced own salt meat in large quantities," "salt meat more expensive now."

Beef. Information concerning usual method of cooking beef: whether boil (or stew), fry, broil, or roast was obtained for those who stated beef had been ordinarily served once a week or more. As may be noted from table 28, there were comparatively few families in which beef had been served in both homes (own and parental family of homemaker) as often. This was, of course, because many of the homemakers had been reared in farm homes where beef was seldom used regularly throughout the year. There was apparently more frying, broiling, and roasting of beef, less boiling than in case of parental families. The most frequent explanation for this change was "family member preferences." Other causes for changes mentioned were: "equipment," "doctor's orders" "new recipes tried," "takes less time," "market," "healthier," "cook for fewer than in parental family," "easier to prepare."

Information was obtained for the period just before rationing of beef. Some of the women interviewed volunteered changes since rationing, such as "hamburger goes further," "new ways of extending beef tried." Several Negro families stated that they had eaten no beef since rationing as they were "afraid of getting mule meat." Negroes use mules rather than horses, as a rule, so this is perhaps their interpretation of the rumors that were making the rounds that butchers were passing off horse meat for beef.

Eggs. Information concerning whether eggs were ordinarily fried, scrambled, or cooked by other methods was secured from those families serving eggs two times a week or more. As shown in table 28, the greatest change in egg preparation had taken place in families of higher housing value. These families more frequently scrambled their eggs, or cooked by some other method as boiling, poaching, or omelet, than had the parental families of the homemaker. Family preference was most often given as the reason for this change. Other explanations included: "More healthful," "easier to prepare," "goes further," "yellow cooks more evenly," "new recipes."

Cooked cabbage. Those homemakers usually serving cooked cabbage or who were served cooked cabbage in parental home two times a month or more when cabbage was in season were asked whether the cabbage served was pink or brownish, or white and green in appearance when served, whether seasoned with meat, cream sauce or fat, and whether smothered or fried, boiled, or steamed.

The greatest change in preparation in all groups was not in type of seasoning, nor in method of cooking, but in length of cooking as indicated by color of cabbage when served. Explanation most often given for change in cooking time was "food and nutrition education." Mentioned in this connection were home economics in school and college, club demonstrations, home agents, trained nurses, housekeeping aids, school lunch supervisor, friends, family members, reading. Many homemakers were no doubt primed to make a change, for on long cooking with generous amounts of fat, as cabbage was often cooked, it develops a very strong flavor and causes many who eat it to have indigestion.

Cooked cabbage was the food in the group of 12 foods in which the greatest change had been made in preparation. The majority in all groups except one prepared cabbage differently from parental family (table 28). A number in the low housing value groups spoke of "smothering" cabbage, or quick cooking in a skillet with a little water and grease. Cabbage cooked by this method was described by these homemakers as "more tasteful," "having more flavor.'

Slaw. As in the case of cooked cabbage, information concerning methods of preparation was obtained for those families serving it as often as two times a month when cabbage was in season. Methods of preparing slaw in own and parental home of homemaker included: with vinegar and seasoning (vinegar dressing), with salad dressing or mayonnaise, and with French dressing. Somewhat fewer families had made a change in method of preparing slaw than had made a change in method of preparing cooked cabbage. More higher housing value families than lower housing value families had made the change. The most frequent change was a shift from vinegar dressing to salad dressing or mayonnaise. Some of the higher housing value families had shifted from salad dressing or mayonnaise to French dressing. The most often explanation for this shift was "market." Salad dressings and mayonnaise are now found in all grocery stores at low selling price. Many homemakers in describing this change used the word "easier."

Milk. Information concerning whether milk for drinking was ordinarily served as "sweet milk" (whole milk) or buttermilk was secured from those families serving milk as often as once a day for as much as 9 months during the year.[10] As shown in table 28, relatively more Negro than white homemakers had shifted. The shift has been in the main from buttermilk to sweet milk. Also, families of a number of the older white women used sweet milk when parental families had ordinarily used buttermilk for drinking. Availability seems to be one of the main factors for this change as evidenced by remarks such as "more sweet milk on market," "can't get buttermilk," "parents had own cows," "buy milk, used to have a cow and churn," "more sweet milk because of refrigeration and pastuerization," "Made more butter when a child, used to sell butter." Other causes for shift given were: "better sweet milk now," "children like sweet milk," "sweet milk has more food value," "children need sweet milk," "trying to gain," "diet," "doctor's advice." Reasons given by the few shifting from sweet milk to buttermilk were: "more economical," "husband likes better," "not as fattening as sweet milk"

Canned tomatoes or juice. The majority of families in all groups prepared canned tomatoes most frequently as had the parental family of the homemaker; that is, as soup. About one-third in each group, however, prepared them differently. Methods of preparation listed included: as come from can, in soup, in spaghetti, all other. Those homemakers who had changed their usual method served more tomatoes as they come from the can, while their parental families had served tomatoes most often in soup. A number of white homemakers stated that their parental families "had had soup too much." The most frequent reason given for shifting from soup to tomatoes from the can was "family likes." Several mentioned the fact that with better canning methods canned tomatoes were more palatable than formerly. A number gave as their reason for the change "easy." Others mentioned "reading," "food value," "healthful" as factors. Information concerning preparation was secured from those families in which homemaker stated that canned tomatoes were ordinarily served twice a week when fresh tomatoes were not in season.

Oranges. A regular supply of oranges, as in the case of beef, was often not available to the parental families of these homemakers. The number of records in which oranges were served in own and in parental home at least once a week from December through April, either between meals or at meals, sliced or as juice, was very limited. From the few records available, it would seem that there has been a greater change in methods of serving in the higher than in the lower housing value groups. Oranges were formerly eaten almost altogether between meals. Some families, especially in the higher housing value groups, have shifted from serving oranges between meals to juice at meals. Reasons given for this shift were: "easier to eat," "equipment now available," "more healthful at breakfast," "doctor's advice," "children like."

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[10] In case of milk, eggs, oranges, or foods which might be served an infant or young child only, the family was regarded as serving the food if it was served to the majority of members of the family.

Canned string beans. There had been less change in preparation of canned string beans than in any other food listed except sweetpotatoes (table 28). The vast majority of homemakers prepared their beans as had their parental families. The two points questioned about canned string bean preparation included whether canning water drained or not, and whether vegetable cooked only 10 or 15 minutes, or cooked for a longer period. As will be noted in table 28, higher housing value family homemakers somewhat more often prepared their canned beans unlike their parental families than did lower housing value family homemakers. The higher housing value family homemakers more often used the canning water and cooked their beans a shorter time. Factors causing these changes most often mentioned were better canning methods, including equipment. Other reasons given were: "healthful," "like better," "reading," "food value."

Draining and long cooking of canned string beans are no doubt results of canning methods used in the past, including open kettle or water bath with acid (usually vinegar) added to the beans. These methods are still used, but not as generally as they were in the parental homes of homemakers. Canned beans were not used in parental homes of the oldest homemakers, for drying or brining was the method of preservation in general use then.

Sweetpotatoes. Those homemakers usually serving sweetpotatoes or who were served sweetpotatoes in parental homes three times a week or more when in season were asked about the most frequent method of preparation: baked, candied, fried, other. As shown in table 28, the majority of homemakers prepared sweetpotatoes as had their parental family, usually baked. However, some families ordinarily used other methods more often, especially so white families in higher housing value groups. Preferences of husband, children, or self was the most frequent explanation for this change. Several mentioned saving fuel as a factor in change from baking to candying. These were often families with gas or electric stoves. Baked sweetpotatoes are especially adapted to the family having a wood or coal range in which baking may not involve extra fuel.

Preparation of fresh vegetables and fruits in both homes. The second method used in comparing food preparation in own and in parental home was questioning the homemaker concerning whether more, the same, or less, water and fat were used in cooking fresh vegetables than in parental home and whether the cooking time was longer, the same, or less, as well as the principal vegetables in which these changes had been made, and factors, if known, responsible for changes. A list of some of the common methods of preparing fresh vegetables and fresh fruits was given and the homemaker asked to state if any of these methods were now used more frequently and if so, the cause or causes for increase in use.

Amounts of water and fat and cooking time in preparing fresh vegetables.

As may be noted in table 30, the majority of women in all groups stated that fresh vegetables were cooked in less water and for a shorter time than they had been cooked in their parental homes. The majority in all except one group stated that about the same amount of fat was used as formerly.

More younger than older women, however, used about the same amount of water and of fat and cooked about the same time as their parental families. Homemakers residing in homes of higher housing value had more often made a change than had those residing in homes of lower housing values. Thus, 58 percent of the white women of 40 years and under in the $20.00 and under housing group stated they cooked vegetables a shorter time than they had been cooked by their parental family, while 75 percent in the same age group with housing values of $20.01 to $40.00 and 69 percent with values of over $40.00 stated they cooked vegetables less than had their parental family. The number of records in the over $40.00 housing group with wife 40 years and under is quite limited.

Changes of younger Negro women corresponded with those of younger white women of the same housing value group more than did changes of older Negro and white women. Older white women were much more inclined to change than were older Negro women (table 30). This may be in large part because of the very limited schooling of older Negro women.

As a rule, reduction in cooking time was accompanied by reduction in amount of water. A few homemakers using gas as fuel, however, stated that it required more water to cook vegetables with gas than it did with wood or coal.

Principal reasons given for reduction in cooking time and in amount of water used in preparation of fresh vegetables were: "like better," "healthier," "reading," "education in home economics class," "home agent," "white woman," "new type of equipment" (that is, waterless cooker, steamer, gas stove), "gas cooks quicker," "too busy to spend much time in kitchen," "don't like pot liquor," "used to have plenty of fuel, now have to buy," "have smaller family, therefore do not have to extend vegetable by boiling long time in lots of water," "to keep in style."

The vegetable which was most often mentioned as being cooked a shorter time in less water was cabbage. The next in importance was turnip greens. Both of these vegetables develop a strong flavor on long cooking. It would thus seem that these are the vegetables which home economists should first use to demonstrate merits of short cooking in little water.

Other vegetables quite frequently mentioned as being cooked less and in less water were: leafy vegetables, potatoes, and string beans. About one-twelfth of the white families reporting and one-fifteenth of the Negro families reporting stated that shorter cooking and less water were used for "all vegetables."

Factors mentioned by the few homemakers who cooked vegetables in more water and for a longer time than did their parental families were: "influence of the South," "water easier to get," "have more fuel," "husband has no teeth," "like pot liquor better than the vegetable."

The principal reason given for using less fat than formerly was that fat was less plentiful than in their farm home. It had to be purchased now;

Table 30. Proportion of families showing similarity and difference in uses of water and fat and in cooking time of fresh vegetables in home of family now and in home of parental family of homemaker when she lived at home, classified by housing value and race of family and age of homemaker.

Item	White families		White families		White families		Negro families	
	Housing $20 and under		Housing $20.01-$40		Housing over $40		Housing $20 and under	
	Homemaker		Homemaker		Homemaker		Homemaker	
	Over 40 years	40 yrs. and under	Over 40 years	40 yrs. and under	Over 40 years	40 yrs. and under	Over 40 years	40 yrs. and under
Total families	150	159	203	135	36	15	195	263
No. records of amt. water*	127	143	168	119	30	13	168	236
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
More than parental family	2	8	0	1	0	0	1	2
Same as parental family	30	42	24	32	23	38	47	48
Less than parental family	68	50	76	67	77	62	52	50
No. records of amt. fat*	124	141	164	116	28	12	165	231
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
More than parental family	7	10	6	3	7	0	7	8
Same as parental family	45	57	52	52	50	54	61	62
Less than parental family	48	33	42	45	43	46	32	30
No. records of cooking time*	128	142	170	121	31	13	169	238
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
More than parental family	2	2	2	4	3	0	2	1
Same as parental family	22	40	16	21	19	31	44	45
Less than parental family	76	58	82	75	78	69	54	54

*Records were not secured from all homemakers, as there were a number who did not remember.

then, it was home produced. Other reasons often given were "too much fat isn't healthy," "noticed way mother-in-law cooked." From one-third to about one-half of the homemakers in each of the eight groups of families stated they used less fat in cooking vegetables than used by parental family (table 30). One or more homemakers in every group except one said they used more fat than had been used in their parental home. Reasons given for this change included: "like rich foods," "have more money to buy fat," "market closer," "fat makes vegetable tender."

String beans was the vegetable most often mentioned by white women, turnip greens by Negro women, as the vegetable in which less fat was used than in their parental home. More homemakers mentioned less fat in "all vegetables" than mentioned shorter cooking or less water in "all vegetables." One in every 10 women (both white and Negro) stated that less fat was used in cooking "all vegetables" than had been used in their parental home.

Methods ordinarily used in preparing fresh vegetables and fruits. The proportion of homemakers using specific methods of preparing vegetables and fruits more than did their parental families does not show as consistent differences in families of older and younger women as was shown in other tabulations by age groups (table 31). Salads, vegetable as well as fruit, were however, much more frequently prepared in homes of older women than in homes of their parents, than in the case of younger women and the homes of their parents. In fact, more frequent use of salads seems to be the outstanding change in methods of using fresh vegetables and fruits. The widespread use of salads no doubt waited the development by industry of palatable cheap dressings with good keeping qualities and of ice or mechanical refrigerators. "Mother didn't know about salads" was a phrase heard a number of times.

Families of higher housing value have much more frequently changed to baking and/or scalloping and making salads of their fresh vegetables than have families of lower housing value where frying or smothering is somewhat more important than formerly.

Table 31 shows that more women seasoned fresh vegetables with butter or margarine and with cream sauce than had parental families of these women. Especially was this the case of women in the higher housing value groups.

The reasons for these shifts in preparation and in seasoning of fresh vegetables most often given by the women were recipes from friends, relatives, children, magazines, home agent, radio, white woman. Among other reasons given were: "husband doesn't like vegetables, so I prepare them all kinds of ways to find one way he will eat them," "so few in family can try out new ways," "salads are stylish," "better oven," "ready-prepared dressing and mayonnaise at grocer's."

From 30 to 90 percent of the homemakers in every group used raw fruit more at meals, between meals, and in salads than had their parental families (table 31). Comparatively few women stewed raw fruit or served it in pies and cobblers more than had their parental families, and these women were usually in the lower housing value groups.

Reasons given for shifts in fruit preparation were: "family preferences," "new recipes," "food value of salads," "to be in style," "market," "ease of preparation." Reasons for shift from cobblers and pies to raw fruit often given were: "don't have to extend fruit in cobblers and pies as used to," "prefer fruit raw," "to save time," "doctor's advice," "too lazy to cook."

Table 31. Proportion of homemakers using one or more specific methods of fresh vegetable and fruit preparation more than was used in their parental families classified by housing value and race of families and age of homemakers.

Item	White families		White families		White families		Negro families	
	Housing $20 and under		Housing $20.01-$40		Housing over $40		Housing $20 and under	
	Homemaker		Homemaker		Homemaker		Homemaker	
	Over 40 years	40 yrs. and under	Over 40 years	40 yrs. and under	Over 40 years	40 yrs. and under	Over 40 years	40 yrs. and under
Total families	150	159	203	135	36	15	195	263
No. homemakers who use (a) one or more of following methods of preparation or (b) seasoning fresh vegetables more than parental family*:	100	127	140	100	25	10	97	158
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
(a) Fried**	23	20	10	15	4	10	27	16
Boiled	0	0	0	6	12	10	2	1
Baked or scalloped	17	13	25	20	32	40	25	24
Salad	81	47	88	60	88	50	52	44
(b) Butter or oleo	48	42	60	39	72	50	38	42
Cream sauce	15	18	60	52	52	30	5	18
No. homemakers who use one or more of following methods of serving or of preparing fresh fruit more than parental family*:	93	113	130	90	20	9	81	129
	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.	Pct.
Raw between meals	55	40	50	40	40	—	63	42
Raw at meals	39	40	61	60	70	—	37	40
In salad	65	63	90	80	90	—	41	30
Stewed	14	10	6	7	5	—	0	2
In pies	12	7	3	7	0	—	12	12
In cobblers	6	5	1	6	0	—	4	3

*In the group not included are those who used all methods less or the same as parental family and those who did not remember.

**Homemakers call this method frying; some call it "smothering." A better term would be "panbroiling"—cooking in a skillet a short time with a little water and grease.

SUMMARY

The data of this study were gathered by personal interviews with 1,158 white and Negro families living in four small towns of Mississippi—Marks and Tunica in the Delta Area, and Eupora and Ackerman in the Short Leaf Pine Area. The purpose of the study was to examine some of the changes that are taking place in food preparation of small town families of Mississippi, the factors underlying these changes, and the implications of these changes and factors.

Two methods were used in studying the changing food preparation pattern of these families: (1) studying new dishes (that is, new foods or new combinations or ways of preparing old foods) tried during past year; (2) studying preparation of particular foods in families as compared with preparation used in parental families of homemakers when they resided at home.

Tests showed that a good method of classifying families for this study was by race and monthly rent or rental value of house in which the family resided (i.e., housing value). On the basis of these tests, white families were classified into four housing value groups, Negro families into two housing value groups.

New Dishes Tried During Past Year

In the large majority of families of this study, both white and Negro, one or more new dishes had been tried during the report year. A larger proportion of white families, however, in the $7.51 to $20.00 and the $20.01 to $40.00 groups tried such dishes than did families in other groups. Families in these two housing groups also averaged more new dishes tried. Of the total number of new dishes tried, relatively more of those tried in families of lower housing value were desserts than in case of those tried in higher housing value families; relatively more of those tried in families of higher housing value were salads than in case of those tried in families of lower housing value.

Thirteen percent of all the new dishes tried were also new foods. Eighteen percent of the new foods tried were rated as poor or fair. Three percent of the new combinations of familiar foods were thus rated. Sixty percent of the dishes receiving fair or poor rating were vegetable dishes.

The most important source of suggestions to the homemaker for the new dishes tried during the report year was friends. Recipes from magazines, newspapers, and cookbooks were relatively more important in higher housing value groups, advertisements in lower housing value groups. Suggestions for new dishes tried by the Negro woman often came from the white woman.

The main trends in new dishes of various food types prepared were: **Desserts** (1) substitution of corn sirup, molasses, condensed milk and other alternates and substitutes in part or in whole for sugar by all housing value groups, but especially by the $7.51 to $20.00 and $20.01 to $40.00 white groups; (2) use of mixes (especially pudding, cake); (3) use of fruits and fruit juices in dessert preparation. **Vegetables** (1) trying vegetables that had not before been used by the family; (2) using scalloped dishes (especially in higher housing value groups); (3) using "panbroiling" (especially in lower housing value groups). **Meat or meat alternates** (1) extending flavor by addition of other foods (especially in lower housing value groups); (2) use of new poultry dishes and new luncheon and canned meat dishes (especially in higher housing value groups); (3) use of new dishes made from variety meats (especially in the low housing value Negro group. **Salads** (1) use of vegetables of all kinds in salad. **Fruits** (1) new ways of preparation rather than use of new fruits. **Breads and cereals** (1) use of ready-prepared cereal dishes (especially in the $7.51 to $20.00 and $20.01 to $40.00 groups of white families); (2) 15 percent of new bread and cereal dishes involved a shift to a grain product (or legume used as a grain product) not before served in any form, or to a whole-grained cereal when formerly only the refined products had been used. **Food preservation** (1) towards greater variety of vegetables canned.

Differences in Food Preparation in Own and in Parental Home of Homemakers

A comparison of usual method of preparing or serving cornbread, biscuit, salt pork, beef, eggs, cooked cabbage, slaw, milk, canned tomatoes or juice, oranges, canned string beans, and sweetpotatoes in families with the methods ordinarily used in preparing these foods by parental families of homemakers showed that the majority of homemakers in all groups prepared all of them except two—cooked cabbage and slaw—as had their parental families. But a number of homemakers in every group reported preparing each of the other 10 foods differently from the way they were prepared in their parental homes. Differences in food preparation in own and in parental homes were more marked for families in which the homemaker was over 40 years of age than for families in which she was younger. Families of higher housing values had on the whole made more changes than families of lower housing values. Negro families had made somewhat fewer changes than had white families.

Preference by self, by husband, by children, or by family, for the food prepared by method used was more often given as the reason for difference in preparation than any other. Other reasons given were: food and nutrition education, change in market (in location or in goods carried), cheaper, takes less fuel. The discrepancy in reasons secured by first and by the second methods of studying changing pattern of food preparation is explained by the fact that the first method gives the final factor that caused action, the second method the factor the homemaker considered most important.

A comparison of methods of preparing fresh vegetables and fruits by families with those which had been used by parental families of homemakers showed main trends in preparation of these foods to be shorter cooking of vegetables and greater use of vegetables and fruits in salads.

Changing Food Preparation

This study shows that changes have been and are being made in food preparation by small town Mississippi homemakers. Extent and type of change varied in different groups and this is not surprising, for environments differed. It would thus seem that the best approach to improving food preparation among families such as these would be an environment centered rather than a family centered approach. Every factor in environments of the various groups must be made to work for better food preparation.

Implications of Findings for Food Education Programs

1. **More effective use of friends in bringing about desired changes in food preparation.** This study shows that of those new dishes actually tried in

families, friends were the most important source for suggesting the method or recipe tried. They were most often the final link in causing action. The homemaker may have heard, for instance, of "5-minute cabbage" through her daughter who had a friend who was enrolled in a home economics class, but it took a visit from a friend who had cooked the cabbage and found it good, whose husband and children liked it, to lead this homemaker to action.

Since knowing that some one in one's own group has tried and found good makes a difference in adoption of a practice, it is important to get homemakers in various socioeconomic groups to consciously set out with the idea of getting other homemakers to try improved methods of food preparation. No socioeconomic group is lacking in nutrition-conscious women who can do this job effectively—women who are liked by people and who in turn like people. From this study it seems likely that the maximum number of improved practices would come quickest through best use of local leaders.

2. **Need for emphasizing the fact that recommended practices in preparation mean palatable food.** The fact that many women in both racial and in all housing value groups gave as the reason for differences in preparation of particular foods in own and parental homes—preferences of self, of husband, of children, of family members, shows the importance of first convincing the homemaker and members of her family that the changed practice will produce palatable food—food that tastes good.

3. **More emphasis on the use of familiar foods.** This study showed that the majority of new dishes tried involved the use of familiar foods. Educators need to make a survey of foods used by different groups with which they work (if they have not already done so). Familiar foods are generally used in salad, in desserts, in canning. This fact should be taken into consideration when planning demonstrations.

4. **To shorten cooking time in vegetable preparation.** Among possible factors in overcooking vegetables are: (1) poor time scheduling; (2) preferences for overcooked vegetables developed in early childhood and kept alive by repetition.

The first of these factors—time balancing of menus—will be taken up in a future publication. Possibilities for dealing with the second factor—preferences for overcooked vegetables—suggested by this study are: (1) Demonstrate first short cooking of cabbage, and/or turnip greens, as family members seem to be more willing to change the method where there is a relation in a practice and an unpleasant result; (i.e., strong flavor developed from overcooking such vegetables as cabbage and turnip greens causes many to have indigestion). (2) In advising a reduction in cooking time, it seems wise to suggest also a new type of seasoning, as flavors from seasoning and long cooking are often associated. Reduction in cooking time of string beans may thus be brought about more speedily if short cooked beans are seasoned with butter or margarine. (3) The method of cooking vegetables in a skillet in a small amount of fat and water called "smothering," sometimes known as "panbroiling," seems to be especially acceptable to families in lower housing value groups. Methods used by Chinese and other foreigners who cook in this manner might well be investigated and possibly adapted for use.

5. **Introducing new foods.** In connection with introducing new foods, there are two main problems: (1) the problem of getting the homemaker to

try the food; (2) the problem of getting the family to like the food that is tried.

Some specific suggestions in meeting the first problem derived from this study are: (1) Family members rate as good or excellent most of the new foods the homemaker tries. This means perhaps that the homemaker is not going to try new foods unless she is fairly certain her family will like them. It also means that it is the job of those in the field of food education to provide more opportunities for family members, especially homemakers, to get acquainted with new foods. Refreshments, luncheons, dinners, and suppers in educational groups, as well as in schools, might be utilized to a better advantage for this purpose. (2) A demonstration or lesson in the preparation of a new food should not be given unless the food is available in local stores at the time of the demonstration. Home economists may suggest to local grocers, bakers, and/or butchers, that they offer for sale certain foods especially valuable in nutrients not being carried, promising to show the groups in which they work how to use the food and tell them where it may be secured. (3) Breads from new grains or whole grains might be introduced to the family as bakery products. Homemakers seem more willing to try first these products in a ready-prepared form.

This study shows that the second problem in connection with introducing new foods—that of getting the family to like the new food tried—although not as great as the first, is important, especially in the case of vegetables. Suggestions for getting better family reception on new vegetable dishes coming out of this study are: (1) There is greater family approval when new vegetables are (a) boiled, (b) seasoned with the fat the family ordinarily uses for similar vegetables, (c) mixtures avoided, except in case of new leafy vegetables, such as Swiss chard, spinach, beet tops, kale, which are favorably received if mixed and cooked with turnip greens. (2) There is a need for demonstrations in preparation of the more expensive as well as the cheaper new vegetables. Some families prepared cabbage by better methods than they did cauliflower. (3) There is need for suggesting to grocers and butchers who bring to market new foods, especially new vegetables, new fruits, or new meats in which no information as to preparation is given on the label, how these foods are best prepared, which information can be passed on to customers who decide to buy without knowing how to prepare the particular food.

6. **Need for closer cooperation of home economists with local groups.** Since home economists are only one of many groups who influence the food preparation pattern of families in the community, it is important that they work with other local groups having an influence. Among these groups are grocers, butchers, bakers, physicians, the social welfare agency, the editor of the local paper, the librarian and managers of hotels and cafes.

7. **Need for information concerning relation of preparation to nutritive value to be taught men and boys as well as women and girls.** This study shows that men and boys are an important factor in long run changes in food preparation. This points to need for giving them basic information on relation of preparation to nutritive value.

8. **Need for closer cooperation of home economists with food and equipment manufacturers, advertising agencies, and/or with publishers of women's**

magazines and of newspapers with food sections. (1) Since homemakers often try out new dishes suggested by these groups, it is important that suggestions be technically sound and meet needs of homemakers. Home economists have much to offer these groups and should work closely with them. (2) This study also shows need for teaching homemakers and homemaking leaders discrimination in selection of food preparation material from noneducational sources to be used, or passed on to others for use. (Home economists themselves need more training to do this type of work.)

9. **Since advertising material was more often the final factor of suggestions for new dishes tried than was educational material and educators, it might be well for educational agencies to examine the techniques and printed material used by business in selling.** Perhaps home economists need to study more the psychology of human motivation. Business has long been its students.

10. **Especially desirable times for intensive food preparation education programs.** When population is shifting from rural to urban or urban to rural: Homemakers in this study moving from farm to town often made changes in food preparation. Plans should now be in process of making for assisting the factory worker who is to return as a farm homemaker and the farmer's daughter who will move back to town when her husband returns. Homemakers often changed preparation when new cooking equipment or another kind of fuel was used. The pressure sauce pan which came in just before the war will no doubt be widely used. Plans for best use of this equipment should be in the offing. (Studies of the factors affecting nutritive losses of vegetables in cooking indicate that overcooking in the pressure sauce pan is particularly destructive of vitamins).

11. **Better food preparation for Negroes.** (1) This study shows the importance of instruction in food preparation in lower elementary grades. (2) It indicates need for development of instruction techniques and of recipes better suited for homemakers of little education and of low socioeconomic status. (3) Since white women suggest many new dishes tried, it would seem desirable that white homemakers who come in frequent contact with Negro women be given some training in techniques of rendering more effective assistance in food preparation activities.

12. **Cashing in on good changes wrought by the war.** During rationing of fat and sugar, homemakers have shifted to some extent from frying to other methods of preparation, from use of sugar in desserts to increased use of fruits. It will be necessary for home economists to use their influence in preventing a return to former practices. Lists of improved practices in food preparation that might well be continued might be made out and discussed now at group meetings.

APPENDIX

Table a. Number of families in Ackerman, Eupora, Marks, and Tunica at the time of the study and number from whom schedules were filled out and were not filled out.

Towns	Population 1940 census	No. families in towns at time of study			No. families for whom records were filled out		No. families not eligible*		No. eligible families for whom schedules were not filled out**	
		White families	Negro families	Total	White families	Negro families	White families	Negro families	White families	Negro families
Ackerman	1528	228	133	361	202	112	11	21	15	0
Eupora	1377	203	106	309	170	92	14	7	19	7
Marks	1818	214	224	438	167	189	31	31	16	4
Tunica	1322	185	133	318	159	67	15	62	11	4
Total	6045	830	596	1426	698	460	71	121	61	15

*Ate away from home, no female homemaker, and/or had two or more boarders.
**Could not contact, illness, uncooperative.

Table b. Food and nutrition books owned by white and Negro families.

Name of book	White families	Negro families
	Number owning	Number owning
Home economics textbooks in foods and nutrition	69	9
White House cookbook	71	3
Better Homes and Garden cookbook	56	0
Good Housekeeping cookbook	51	0
American Woman's cookbook	44	1
Church cookbooks	43	0
Women's clubs, PTA, Junior League, and DAR cookbooks	38	0
Boston School cookbook	29	0
Holland's cookbook	15	0
Congressional cookbook	9	0
Cookbooks published by newspapers	7	0
Cookbooks published by magazines not listed above	19	2
All other	21	9
Number of families	698	460

Table c. By whom food and nutrition leaflets or bulletins owned by white and Negro families were compiled.

By whom compiled	White families	Negro families
	Number owning	Number owning
Advertising material	507	162
Mississippi Agricultural Extension	185	10
U. S. Department of Agriculture	54	4
Mississippi Experiment Station	17	2
WPA and ERA	4	0
American Medical Association	2	0
Battle Creek Sanitarium	1	0
Number of families	698	460

Table d. Magazines with a foods section subscribed to or bought regularly by white and Negro families.

Name of magazine	White families	Negro families
	Number	Number
McCalls	150	2
Good Housekeeping	134	3
Ladies Home Journal	115	7
Progressive Farmer	84	9
Woman's Home Companion	87	1
Better Homes and Garden	87	0
American Home	78	0
Hollands	74	0
Southern Agriculturist	45	13
Other magazines—not farm	40	2
Other magazines—farm	36	1
Number of families	698	460

Table e. Use and preparation of 12 foods by white and Negro families in Delta and Short Leaf Pine towns classified by housing value of families.

Use and most usual method of preparation of 12 foods*	White families				Negro families	
	Housing values $7.50 and under	Housing values $7.51-$20	Housing values $20.01-$40	Housing values over $40	Housing values $7.50 and under	Housing values $7.51-$20
Number of families	32	277	338	51	283	175
Cornbread:	Percent	Percent	Percent	Percent	Percent	Percent
Serve 3 times a week or more	91	89	88	78	98	96
Water	14	4	3	3	17	8
Milk	59	27	19	6	68	69
Milk and eggs	27	64	77	86	11	17
More than one**	0	5	1	5	4	6
Biscuit:						
Serve 3 times a week or more	91	77	74	61	88	90
Plain flour	31	69	88	89	57	73
S. R. flour	69	31	12	11	43	27
Enriched flour	18	34	40	54	18	25
Unenriched flour	41	42	36	29	62	50
Do not know whether enriched	41	24	24	17	20	25
Milk	83	94	96	100	79	91
Water	17	6	4	0	21	9
Salt pork:						
Serve 1 time a week or more	63	88	84	74	92	97
As meat	25	18	5	0	0	1
As seasoning	45	73	90	97	25	48
Both	30	9	5	3	75	51
Beef:						
Serve 1 time a week or more	22	57	74	91	39	45
Boil	14	1	0	0	28	23
Fry	57	47	26	21	64	65
Broil	0	14	28	29	2	4
Roast	29	29	30	41	3	7
More than one	0	8	16	7	1	1
Unchecked***	0	1	0	2	2	0
Eggs:						
Serve 2 times a week or more	56	92	93	93	51	67
Fry	72	53	47	37	52	51
Scramble	28	33	36	39	44	45
Other methods	0	0	3	5	0	0
More than one method	0	14	14	19	4	4
Cooked cabbage:						
Serve 2 times a month or more when in season	66	70	67	70	79	79
Brown	19	10	10	9	42	33
White and green	81	90	90	91	58	67
Meat	24	50	49	53	65	62
Fat	76	46	48	38	7	9
Cream sauce	0	1	3	6	0	0
More than one method	0	2	0	0	27	27
Unchecked	0	1	0	3	1	2
Smother or fry	24	8	6	0	24	13
Boil	62	67	67	75	74	80
Steam	14	24	21	25	2	5
More than one method	0	0	6	0	0	0
Unchecked	0	1	0	0	0	2

Table e. (Continued)

Use and most usual method of preparation of 12 foods*	White families				Negro families	
	Housing values	Housing values	Housing values	Housing values	Housing values	Housing values
	$7.50 and under	$7.51-$20	$20.01-$40	over $40	$7.50 and under	$7.51-$20
	Percent	Percent	Percent	Percent	Percent	Percent
Slaw:						
Serve 2 times a month or more when in season	66	82	85	83	35	47
Vinegar	33	12	5	5	34	27
Salad dressing or mayonnaise	48	83	81	74	59	67
Both	19	4	11	5	6	6
French dressing	0	1	3	16	0	0
Unchecked	0	0	0	0	1	0
Milk:						
Serve 1 time a day 9 months or more	66	78	77	76	42	60
Buttermilk	48	10	11	8	67	57
Sweet milk	52	76	82	63	12	17
Both	0	13	7	29	21	26
Unchecked	0	1	0	0	0	0
Canned tomatoes:						
Serve 2 times a week or more when tomatoes not in season	56	70	77	74	35	45
As come from can	39	37	47	59	8	16
In soup	50	39	27	26	71	51
In spaghetti dishes	11	8	9	6	6	8
Other methods	0	2	0	0	5	9
More than one method	0	13	17	6	8	16
Unchecked	0	1	0	3	2	0
Oranges:						
Serve once a week or more, Dec.-Apr.	38	70	85	89	28	46
At meals: Slice	8	9	15	7	3	5
Juice	17	24	39	78	11	20
Between meals	75	66	42	12	78	66
More than one method	0	1	3	3	4	9
Unchecked	0	0	1	0	4	0
Canned string beans:						
Serve 2 times a month or more when string beans not in season	63	74	84	78	81	92
Drain liquid	50	45	44	42	87	86
Do not drain	50	55	56	58	13	14
Season and heat****	5	23	25	33	10	15
Season and cook*****	95	77	75	67	90	84
Unchecked	0	0	0	0	0	1
Sweetpotatoes:						
Serve 3 times a week or more when in season	72	70	75	59	99	98
Baked	70	73	66	67	72	58
Candied	13	13	23	19	6	16
Fried	17	2	1	0	6	5
More than one method	0	12	10	14	16	21

*Method of preparation given for only those using foods as often or more often than listed.

**Most frequent way of preparing given. Where two ways are given and used in about the same frequency, then listed as more than one.

***"Unchecked" means field agent did not get information.

****"Season and heat" means cook 10 or 15 minutes.

*****"Season and cook" means cooking more than 15 minutes.

Table f. Use and preparation of 12 foods by white and Negro town families classified by soil area and housing value of families.

	White families				Negro families			
	Delta Area		Short Leaf Pine Area		Delta Area		Short Leaf Pine Area	
	Housing value		Housing value		Housing value		Housing value	
Use and most usual method of preparation of 12 foods	$20.00 & under	$20.01-$40.00	$20.00 & under	$20.01-$40.00	$7.50 & under	$7.51-$20.00	$7.50 & under	$7.51-$20.00
Number of families	90	188	219	150	137	117	146	58
	Percent	Percent	Percent	Percent	Percent	Perecnt	Percent	Percent
Cornbread:								
Serve 3 times a week or more	77	84	95	94	96	94	99	100
Water	8	3	4	3	19	8	15	2
Milk	40	22	27	15	72	74	64	65
Milk and eggs	52	75	63	80	9	18	13	16
More than one	0	0	6	2	0	0	8	17
Biscuit:								
Serve 3 times a week or more	68	66	83	84	84	86	92	98
Plain flour	52	84	69	92	52	64	61	87
S. R. Flour	48	16	31	8	48	36	39	13
Enriched flour	38	36	35	44	21	33	15	12
Unenriched flour	34	32	31	40	69	56	56	38
Do not know whether enriched	28	32	34	16	10	11	29	50
Milk	88	97	93	96	75	90	83	93
Water	12	3	7	4	25	10	17	7
Salt pork:								
Serve 1 time a week or more	81	82	87	87	91	97	92	98
As meat	20	3	18	8	0	0	0	3
As seasoning	65	94	73	84	36	50	16	43
Both	15	3	9	8	64	50	84	54
Beef:								
Serve 1 time a week or more	69	75	47	72	46	47	32	42
Boil	0	0	2	0	24	18	35	34
Fry	50	22	46	20	70	73	57	48
Broil	16	30	11	28	0	6	4	0
Roast	25	43	31	39	3	3	2	17
More than one	9	3	8	13	0	0	2	1
Unchecked	0	2	2	0	3	0	0	0
Eggs:								
Serve 2 times a week or more	87	92	89	94	52	67	50	68
Fry	66	48	49	46	51	50	54	54
Scramble	25	37	36	35	45	48	42	41
Other methods	0	3	0	3	0	0	0	0
More than one method	9	12	15	16	4	2	4	5
Cooked cabbage:								
Serve 2 times a month or more when in season	59	63	74	72	77	80	82	76
Brown	10	10	11	10	34	31	48	39
White and green	90	90	89	90	66	69	52	61
Meat	43	45	49	54	62	62	68	64
Fat	56	52	48	43	7	9	8	9
Cream sauce	0	3	1	3	0	0	0	0
More than one method	1	0	1	0	29	27	24	27
Unchecked	0	0	1	0	2	2	0	0
Smother or fry	11	7	10	6	23	13	26	14
Boil	65	66	65	67	75	80	72	79

Table f. (Continued)

Use and most usual method of preparation of 12 foods	White families				Negro families			
	Delta Area		Short Leaf Pine Area		Delta Area		Short Leaf Pine Area	
	Housing value		Housing value		Housing value		Housing value	
	$20.00 & under	$20.01-$40.00	$20.00 & under	$20.01-$40.00	$7.50 & under	$7.51-$20.00	$7.50 & under	$7.51-$20.00
	Percent	Percent	Percent	Percent	Percent	Perecnt	Percent	Percent
Steam	24	20	24	21	2	4	2	7
More than one method	0	7	0	6	0	0	0	0
Unchecked	0	0	1	0	0	3	0	0
Slaw:								
Serve 2 times a month or more when in season	75	84	73	86	42	48	28	44
Vinegar	11	3	13	7	31	23	39	33
Salad dressing or mayonnaise	83	82	82	79	63	72	54	59
Both	6	11	5	12	5	5	7	8
French dressing	0	4	0	2	0	0	0	0
Unchecked	0	0	0	0	1	0	0	0
Milk:								
Serve 1 time a day 9 months or more	61	68	83	88	37	51	47	78
Buttermilk	9	9	15	13	59	55	74	60
Sweet milk	86	86	70	77	21	21	4	12
Both	5	5	14	10	20	24	22	28
Unchecked	0	0	1	0	0	0	0	0
Canned tomatoes:								
Serve 2 times a week or more when tomatoes not in season	76	78	66	76	38	48	32	40
As come from can	45	46	33	49	8	18	8	13
In soup	33	29	44	24	70	50	73	52
In spaghetti dishes	15	8	5	11	5	7	6	9
Other methods	0	0	3	0	8	9	5	9
More than one method	7	17	14	16	8	16	8	17
Unchecked	0	0	1	0	1	0	0	0
Oranges:								
Serve once a week or more Dec.-Apr.	73	84	64	86	30	45	33	48
At meals: Slice	6	14	10	16	5	6	2	5
Juice	25	42	23	36	12	25	10	11
Between meals	69	42	66	43	76	69	80	59
More than one method	0	1	1	4	5	0	4	25
Unchecked	0	1	0	1	2	0	4	0
Canned string beans:								
Serve 2 times a month or more when string beans not in season	72	83	73	85	82	92	80	92
Drain liquid	50	46	43	41	85	85	89	87
Do not drain	50	54	57	59	15	15	11	13
Season and heat	22	25	21	25	10	14	10	17
Season and cook	78	75	79	75	90	84	90	83
Unchecked	0	0	0	0	0	2	0	0
Sweetpotatoes:								
Serve 3 times a week or more when in season	69	73	71	78	99	97	99	100
Baked	70	65	74	68	70	57	75	60
Candied	13	20	13	16	7	18	5	10
Fried	5	1	4	2	6	5		5
More than one method	12	14	9	14	17	20	14	25